ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

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ABSTRACTS

02550 **Aamot, Haldor W. C.** Instruments and methods—Instrumented probes for deep glacial investigations [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 321–328, illus., 1968.

Thermal probes can carry instrumentation packages into polar ice sheets for geophysical investigations and long-term observations by remote measurement methods. They are self-contained surface-controlled devices. The development work at U.S. Army CRREL solved problems of materials, fabrication, and heat-transfer analysis. The Philberth probe, named after its inventor, has demonstrated its performance capability in Greenland. The pendulum probe is a further development with increased performance and versatility. The probes are a tool to widen Man's knowledge in glaciology and geophysics, and to increase his capability in seismics and possibly communications.—Author's abstract

07518 **Adams, C. G.** Tertiary foraminifera in the Tethyan, American, and Indo-Pacific provinces, *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 195–217, tables, 1967.

Foraminifera, particularly the larger foraminifera, are important in the recognition of faunal provinces because of the relative ease with which they can be identified and traced over wide areas. Evidence for the recognition of two very different provinces in the circumtropical zone is presented. A third province corresponding geographically to the old Tethys Sea, is less well-marked but contains faunas which reflect its geological history. The distribution of genera within these provinces [particularly migration into and out of Central America] is largely accounted for by the present day circulation of surface waters in the oceans. The significance of provincialism is discussed briefly in relation to Tertiary correlation and to the theory of continental drift.—Author's abstract

07478 **Adams, R. D.** A computer program for computations associated with the hydrometer method of size analysis: Louisiana State Univ. Coastal Studies Bull. 1 (Tech. Rept. 40), p. 43–47, 1967.

In deltaic, marginal deltaic, and estuarine environments, there is a great variability in textural properties of sediments within one environment, especially where most of the sample is finer than 62.5 microns. The great number of samples necessary to characterize these environments can be analyzed consistently by the hydrometer method of size analysis. The program, written to solve the equations involved, uses an IBM 740 computer, and is equipped with calibration data for A.S.T.M. hydrometers 15943, 15966, 40880, 1633840, and 1633861. The program is given in an appendix.—ESL

07429 **Adler, Hans H.; Sharp, Byron J.** Uranium ore rolls—Occurrence, genesis and physical and chemical characteristics, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 53–77, illus., table, 1967.

Uranium ore rolls are accumulations of ore which do not show conformity to the sedimentary trends of the rocks which enclose them. In general they are redistributed deposits resulting from the movement of the salts by ground water in the sedimentary rocks; motion is generally confined in some way. Advancing oxidizing water, for

instance, will remove ore from a deposit and when the water moves into reducing zones in the rocks, the salts precipitate in curved deposits. Permeability also affects the shape of the resulting roll. The chemistry and mineralogy of the ore-roll environment is not well known; a summary of some of the features is given. The theory and practice of logging to detect ore rolls is outlined also.—HRC

07476 **Adler, I.; Trombka, J.** Rock analysis by alpha excitation of X-rays—A possible lunar probe, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 2: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 929-943, illus., table, 1967.

An X-ray spectrograph using alpha particle excitation of characteristic X-rays, proportional counter detection, and pulse height analysis has been constructed and evaluated and a prototype of a flight instrument is presently being assembled. The reduction of the observed pulse height spectra to energy spectra is performed by Trombka's linear least squares analysis program. The results show excellent promise for classifying the common rock types.—Authors' abstract

Akimoto, Syun-iti. *See* Fujisawa, Hideyuki. 02331

Alabama Geological Survey. *See* U.S. Geological Survey. 07523

Alabama Oil and Gas Board. *See* U.S. Geological Survey. 07523

02510 **Alf, Raymond M.** A spider trackway from the Coconino Formation, Seligman, Arizona: Southern California Acad. Sci. Bull., v. 67, pt. 2, p. 125-128, illus., 1968.

Comparison of living spider trackways with a set of tracks found in the Permian Coconino Formation leads to the conclusion that the fossil tracks are spider tracks. The trackway occurs on two matching sandstone slabs, one showing the mold, the other the cast. There are 10 groups of prints, each with 3 points in a forward line with one point behind the inner of the 3 forward points. Measurements were averaged with the following results: length of stride, 3.1 cm; width of the three forward points, 1.2 cm; angle between the forward points and rear point, 72°; distance between right and left prints, 3.5 cm.—BSH

02263 **Allan, R. J.; Hole, F. D.** Clay accumulation in some Hapludalfs as related to calcareous till and incorporated loess on drumlins in Wisconsin: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 403-408, illus., tables, 1968.

A boundary (γ) between the dark, acid solum and the paler calcareous dolomitic sandy loam till in drumlin profiles is related to carbonate content of the till, silty coverings, and eluviation of clay from incorporated loess. In absence of silty covering, clay accumulation above γ was not influenced by carbonate content because the solum deepened by leaching at the same rate as clay accumulated. Coarse silt of the silty covering is mineralogically similar to coarse silt of the till beneath the sola. Leaching has concentrated coarser and less weatherable fractions in the lower B horizon adjacent to the γ. Clay did not accumulate immediately above the coarser till. Dolomite content of the carbonate fraction of the till 5 cm below γ of 6 profiles averaged 95.6 percent compared with 97.0 percent at 55 cm lower, indicating the dissolved carbonate from the solum did not form a distinct Cca horizon.—*from* Authors' abstract

Allen, B. L. *See* Goss, D. W. 02256

02580 **Allen, C. R.; Grantz, A.; Brune, J. N.; Clark, M. M.; Sharp, R. V.; Theodore, T. G.; Wolfe, E. W.; Wyss, M.** The Borrego Mountain earthquake, April 8, 1968 (April 9, GCT): Seismol. Soc. America Bull., v. 58, no. 3, p. 1183-1186, illus., 1968; California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 7, p. 103-106, illus., 1968.

This largest earthquake felt in California in 15 years was felt throughout most of southern California, but with no severe damage, due to its remote epicenter in the Ocotillo Wells area. Caused by right-lateral displacement along the Coyote Creek fault—a major branch of the San Jacinto fault zone—the break has two NW

trending en echelon segments, with a maximum noted displacement of 38 cm northwest of Ocotillo Wells. The trace was within Quaternary alluvium and lake beds, except at the northernmost extremity, where branches cut steeply dipping beds of the Palm Springs Formation, and in Ocotillo Badlands where the Borrego Formation and Ocotillo Quartzite were displaced. In every area of pre-existing faults, the rupture followed earlier breaks. Minor breaks and creep, noted up to April 28 on other faults in the system, must have been triggered by this earthquake.—GDC

Allmann, R. *See* Donnay, Gabrielle. 02559

07462 **Am. Assoc. Petroleum Geologists; SEPM.** (Pacific Sections). Gabilan Range and adjacent San Andreas fault—Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., 110 p., illus., tables, geol. maps, 1967.

Roadlogs for two trips, and one exit and four alternate logs are accompanied by 14 papers and a geologic map which are cited separately. The trip covers the granitic terrane of the Gabilan uplift and the Tertiary formations along the eastern flank; it crosses and recrosses the San Andreas fault in an area where movement is being measured. This trip, with that for 1963, completes the geologic picture of the Salinas Valley and contiguous mountains. The two maps cover an area 100 mi long and 35 mi wide, at two miles to the inch.—ESL

02271 **Amoros, J. L.; SanMiguel, A.** The pressure field and the internal constitution of the Earth: Tectonophysics, v. 5, no. 4, p. 287–294, illus., tables, 1968.

The effect of pressure on ionic compounds can be deduced from the elemental concept of electronegativity. The increase with pressure of effective electronegativity of an atom in a compound corresponds to a decrease in ionic character of the ionic-covalent bond in agreement with deductions from studies of electronic transitions of solids under pressure. Therefore, the increase in covalent bond character is correlated with increase in pressure in the Earth field. With increasing pressure, solid phases with low compressibility and high packing index are stable. A change from coordination 4–6 for silicon is associated with the change silicates to oxides; in the upper mantle geochemical differentiation of K, Na, Ca, Mg, Fe can be explained in terms of diffusivity of such elements under pressure.—*from* Authors' abstract

Anders, E. *See* Mazor, E. 07329

Anders, Edward. *See* Barker, John L., Jr. 02338

07337 **Anders, Edward.** On the origin of meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 99–100, 1967.

Andersland, O. B. *See* Dillon, Howard B. 07370

02400 **Anderson, F. D.** Woodstock, Millville, and Coldstream map-areas, Carleton and York counties, New Brunswick [with French abs.]: Canada Geol. Survey Mem. 353, 68 p., illus., tables, geol. maps, 1968.

The three map-areas lie within the northeastern continuation of the Appalachian Highlands. Oldest exposed rocks are Cambrian–Ordovician sedimentary, overlain by Silurian containing iron and manganese. Devonian sediments and basic volcanic rocks of Late Silurian or Early Devonian age occur, but relations with older rocks are not known. Granite, gabbro, and allied rocks intruded Silurian and older strata during the Devonian. Resting unconformably on the older rocks are nearly flat lying, coarse clastic, continental rocks of Carboniferous age. The pre-Carboniferous strata are highly folded and contorted, possibly as a result of compression from the southeast and a shear along northeast-southwest lines, with the southeast side moving southwest. The map-areas show effects of glaciation, with the latest movement from the north-northwest.—*from* Author's abstract

07354 **Anderson, F. D.** Geology, Coldstream, New Brunswick: Canada Geol. Survey Map 1191A (also in Mem. 353), scale 1:63,360, 1967.

07355 **Anderson, F. D.** Geology, Woodstock, New Brunswick: Canada Geol. Survey Map 1190A (also in Mem. 353), scale 1:63,360, 1967.

07356 **Anderson, F. D.** Geology, Millville, New Brunswick: Canada Geol. Survey Map 1189A (also in Mem. 353), scale 1:63,360, 1967.

07458 **Anderson, F. D.** Structural studies in the Baie d'Espoir Group, Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 193–200, illus., 1967.

This Middle Ordovician(?) group, largely slate and siltstone and metamorphosed equivalents, best exposed around Bay d'Espoir in southern Newfoundland, is divided into four structural zones. The most northern is characterized by highly folded strata with well developed axial plane cleavage; axial planes dip 45° to 65° N.W.; axes are nearly horizontal. The next has more intensely folded strata with subhorizontal cleavage, shear folds, axial planes dipping gently S.E., and axes nearly horizontal. The third is a zone of relatively undisturbed strata with broad open folds, and the fourth, the most southern, contains highly faulted and metamorphosed north dipping strata. Meso- and mega-structures particularly in zone 2, indicate the following sequence of deformation: folding, development of subhorizontal cleavage, folding, faulting.—GDC

02570 **Anderson, Jay Earl, Jr.** Geologic map of central Davis Mountains, Jeff Davis County, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 36, scale 1:62,500, sections, separate text, 1968.

The central Davis Mts. consist of pyroclastic units and lava flows of late Eocene to Oligocene age, intruded by stocks, sills, and dikes. Rocks exposed are Cretaceous(?) metamorphosed limestone and sandstone, Tertiary igneous extrusive and intrusive rocks, and Quaternary sediments. Volcanic rocks generally dip southwesterly 3–5°; most faults are vertical with maximum displacement ranging from 25–75 feet. Joints approximately parallel to the regional fault trend resulted from regional tectonic stresses. Laramide faulting provided avenues for upward movement of alkalic, monzonitic magma through Cretaceous sedimentary rocks. Explosive activity began during late Eocene or Oligocene and continued for an undetermined time span. During the intrusive phase, older volcanic rocks were intensely faulted.—MCM

Andrews, George W. *See* Lohman, Kenneth E. 02435

02346 **Andrews, Henry; Kasper, Andrew; Gabbey, Patricia.** Early Devonian plants from northern Maine [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

02373 **Anson, Abraham.** Photographic interpretation from space, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 412–413, illus., 1968.

The most significant feature on infrared aerial photographs taken from Gemini VII in 1965, in flight over the Gulf of Mexico coast in southern United States, is the "blooming" effect of white sand and shell beaches between Louisiana and Florida, and of spoil banks of a recentiy dredged channel from New Orleans to the Gulf and Gulf County Canal near Appalachicola, Florida. Water areas between barrier islands and the mainland indicate by surface reflectance varying amounts of silt. Presence of two large forest fires is revealed by plumes of smoke 65 miles in length. The large cities are outlined by their reflectance; timbered swamp areas and water holes appear black.—GDC

Anson, Abraham. *See* Smith, John T., Jr. 02604

02579 **Arino, H.; Kuroda, P. K.** Spontaneous fission-produced strontium isotopes in uranium minerals and salts: Jour. Inorganic and Nuclear Chemistry, v. 30, no. 3, p. 677–683, illus., tables, 1968.

Sr-89 and Sr-90 were separated from kilogram quantities of 17-yr-old depleted uranium ($^{238}UO_3$), 14- to 15-yr-old natural uranyl nitrate and about 600-m.y.-old Katanga pitchblende, exhaustively purified and counted. Assuming that the Sr-90 in the depleted uranium is formed by the spontaneous fission only, the U-238 spontaneous fission yield for mass chain 90 was calculated to be 5.9±0.6 percent. A value of 3.3±0.3 percent was obtained for the Sr-89 yield. About 20 percent of all the fission events taking place in pitchblende was estimated to be neutron induced fission of U-238 and 80 percent is U-238 spontaneous fission. The data indicated that the ratio of induced fission vs. spontaneous fission in non-irradiated natural uranyl nitrate hexahydrate can be as high as 0.3–0.4—Authors' abstract

Armbrustmacher, Theodore J. *See* Wrucke, Chester T. 02584

02459 **Arndt, Robert H.** Mineral resources and industry of the Pascagoula River basin, Mississippi and Alabama, App. L *in* Pascagoula River comprehensive basin study, V. 6: [Mobile, Ala.] U.S. Army Corps Engineers, p. L1–L34, illus., tables, 1968.

This report discusses minerals and mineral products normally tabulated in the Bureau of Mines' Mineral Yearbook. Compiled data pertain to the Pascagoula drainage basin only, unless otherwise specified. Tables give the stratigraphic distribution and productivity of oil and gas in Mississippi. Crude oil, natural gas, and natural gas liquids generated most of the value of mineral output in the basin in 1965. Sand, gravel, and clay provided significant tonnage. In discussing the output and value of individual substances for 1956–65, source, extent of resources, and future outlook are considered. Iron and bauxite source is outside the basin, but they may have future industrial significance. Salt and lignite possibilities are present within the basin.—GDC

02468 **Avers, Darrell D.; Snyder, Barry L.** Stratigraphy of the lower and middle Council Grove Group ("Early Permian"), southeastern Nebraska and eastern Kansas [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 18, 1968.

07338 **Axon, H. J.** The mechanical and thermal alteration of iron meteorite structures [abs.]: Meteoritics, v. 3, no. 3, p. 100, 1967.

02471 **Bado, John T.** Geology of the North Mustang and South Yukon fields, T. 11 N., R. 5 W., Canadian County, Oklahoma: Oklahoma Geology Notes, v. 28, no. 3, p. 95–104, illus., table, 1968.

Oil and gas production is limited to a single gas well in the North Mustang field, and two oil wells in the South Yukon field. Gas occurs in a thin, porous unit of the Pennsylvanian Prue sandstone which appears to have limited areal distribution and production capabilities. In nearby areas it has worthwhile reserves. To date, oil production has been from the Haragan-Henryhouse unit of the Hunton Group, a series of Silurian-Devonian limestones and dolomites, although tests have shown possibilities of good production from the Ordovician Viola Limestone. A promising zone appears to be the Bois d'Arc unit of the Hunton Group. While production from this zone has not been found in this township, favorable characteristics warrant future exploration with good results. A table summarizing the drilling and development history of Canadian County, structure contour and isopach maps, and electric logs are included.—BSH

Bailey, S. W. *See* Dalziel, I. W. D. 02451

02387 **Bailly, Paul A.** Exploration methods and requirements, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 19–42, illus., table, 1968.

The four main stages of exploration in 10 successful ventures are tabulated in detail. An exploration plan should be flexible to take advantage of lucky discoveries, and

the group organized so as to be successful. Planning a drilling program, sampling, reserve estimating, and mine planning are discussed.—ESL

02255 **Bair, F. L.; Pratt, P. F.** Lithium–calcium exchange equilibria in soils and clays: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 438–440, illus., table, 1968.

Cation-exchange equilibria at pH 7 were determined for a number of soils and clays using Li adsorption ratios (LAR) of 0.2 to 20 $(\text{moles/liter})^{0.5}$. Data for montmorillonite and montmorillonitic soils gave linear relationships between exchangeable Li ratio (ELR), or ratio of exchangeable Li to exchangeable Ca and LAR; similar slopes were obtained in all cases. However, relationships between ELR and LAR for kaolinite and kaolinitic soils were all curvilinear with a relatively high adsorption affinity for Li at low Li concentrations, indicating that this affinity for Li existed only in a small fraction of the cation-exchange capacity of these materials. Drying in a Li-saturated form increased the affinity of kaolinite for Li but had only a small effect on montmorillonite.—Authors' abstract

02269 **Balci, A. N.** Soil erosion in relation to properties of eastern and western Washington forest soils: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 430–432, tables, 1968.

Soil was sampled under Douglas-fir stands located on similar parent materials in eastern and western Washington. Simulated rainfall applied to soil blocks showed real differences in erodibility of east- and west-side soils. All soil properties tested, except texture, differed significantly between the two locations. Over 70 percent of the variation in soil erodibility was accounted for by a multiple regression equation using erodibility as the dependent variable and loss of ignition, permanent wilting percent, and percent silt as independent variables. Differences in soil properties were attributed to influences of climate on production of plant litter and ensuing decomposition and incorporation of litter in soil by organisms.—Author's abstract

07467 **Baldwin, T. A.** Morphologic clues to geologic history—The northern Salinas Valley and San Andreas fault, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 92–93, illus., 1967.

Landforms and drainage patterns in this area of California are the residual effect of Pliocene–Pleistocene topography altered by late Pleistocene and recent structural deformation. In early Pleistocene time, a river system drained the area through the San Benito Valley; this was joined by a northern branch, the resulting major river reaching the sea at Monterey Bay through what is now Elkhorn Slough. This river probably cut the submarine canyon, and may have been in existence since mid-Miocene. In Oligocene and Miocene, a seaway existed between the land area now the Diablo Range and that including the present Gabilan Mesa and Ben Lomond Mtn.; later there was overlap of the sediments in the seaway by Pliocene sands, forming a possible oil trap. A sketch map shows Pleistocene topography.—ESL

Barghoorn, E. S. *See* Eyde, R. H. 02318

02327 **Bariss, Nicholas.** A comparative landform study of selected loess areas in the Missouri River Basin . . ., *in* Loess and related eolian deposits of the world Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 81–99, illus., table, 1968.

This paper presents some results of a study of the topographic characteristics of loess-mantled terrain in Nebraska and Iowa. Distance from the source, thickness and sand content of the Peorian loess, and configuration of the sub-Peorian surface control terrain characteristics to varying degrees. Effects of the first three factors are quantitative. The first three stages of valley formation are affected by the peculiar characteristics of the loess. Therefore, the common morphological characteristics of loess terrain are the small-scale features associated with the first three valley formation stages. Comparison between Nebraska and Iowa loess areas

suggests that, for large-scale features, no uniform topography exists, if controlling factors differ greatly.—MST

02338 **Barker, John L., Jr.; Anders, Edward.** Accretion rate of cosmic matter from iridium and osmium contents of deep-sea sediments: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 627–645, illus., tables, 1968.

Concentrations of Ir and Os were measured in dated deep-sea sediments by neutron activation analysis to set limits on the influx rate of cosmic matter. Twenty-one measurements on five cores from the central Pacific gave Ir and Os contents from 0.06 to 0.4 ppb; Ir and Os correlate with each other—$Ir=(1.2\pm0.2)Os$—and both tend to increase with decreasing sedimentation rate. With an assumed Ir content of 0.42 ppm, the value in Type I carbonaceous chondrites, the influx rate for the entire Earth becomes $(6\pm3)\times10^4$ tons per yr. This represents an average over the last 10^5 to 10^6 years. If all the Ir and Os in deep-sea cores is of cosmic origin, the value obtained is between 0.5×10^5 and 1.5×10^5 tons per yr; this upper limit is more than an order of magnitude lower than other estimates based on the Ni content of deep-sea cores or particle counts by meteorites.—DBV

Barnard, Walther M. *See* Metzger, William J. 02232

Barnes, I. Lynus. *See* Funkhouser, John G. 02531

07336 **Barringer, Richard W.** World's meteorite craters ("astroblemes")—Version VII, February 1967: Meteoritics, v. 3, no. 3, p. 151–157, tables, 1967.

In keeping with a decision by the Meteoritical Society to keep a current list of known meteor craters, three tabulations are presented. Table I lists known craters, their locations, proof of meteor origin, and ages. Table II lists suspected astroblemes with locations, diameters, and evidence. Large fall sites with locations and weights of materials removed are tabulated in Table III.—BSH

07346 **Barrows, Gordon Hensley.** International petroleum industry—V. 2, Central America/South America/Africa/Far East/North America (1st edition): New York, Internat. Petroleum Inst., 371 p., illus., tables, 1967.

The volume contains a separate section for each of 124 countries. Exploration and production history, refining, marketing, etc., are covered for twenty countries in the West Indies and Central America, and summarized for Canada and the United States. Histories of 23 international oil companies based in the United States are presented. A special table has been included as an appendix to bring production figures in V. 1, published two years ago, up-to-date. A comprehensive and combined index to both volumes is included. All companies and individuals mentioned in the text, and subject matter and topics for all countries are indexed. Appendix B is a list of maps, charts, graphs, and tables in both volumes.—ESL

07407 **Barss, M. S.; Hacquebard, P. A.** Age and the stratigraphy of the Pictou Group in the Maritime Provinces as revealed by fossil spores [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 267–282, illus., 1967.

The Pictou Group is a transgressive lithostratigraphic unit which is present in many areas of the Maritime Provinces. No continuous sequence of the entire group is present at any one locality, therefore precise correlations had not been established in many instances. Palynological studies of coal and clastic sediments have shown the presence of five zones, each characterized by a distinctive assemblage of miospores: *Vittatina, Potonieisporites, Thymospora, Torispora,* and *Vestispora.* These zones represent Lower Permian, Stephanian, and Westphalian C–D ages. Stratigraphic correlations among twenty sections of Pictou or equivalent strata from different areas have been made by delineating the positions of the various miospore zones in each section.—*from* Authors' abstract

02407 **Baschnagel, Raymond A.** Fossil Myxophyceae from the Middle Devonian of New York [abs.]: Jour. Phycology, v. 4, supp., p. 7, 1968.

Bassett, William A. *See* Takahashi, Taro. 02352

02481 **Bateman, Paul C.** Geologic structure and history of the Sierra Nevada, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt–Geology Dept. Colloquium Ser. 1), p. 121–131, illus., 1968.

Granitic rocks of the Sierra Nevada batholith are Mesozoic in age and have intruded metamorphosed Paleozoic and Mesozoic sedimentary and volcanic rocks. The batholith is part of a large province of intrusions along the west coast and is localized in the axial region of a complexly faulted synclinorium. It is largely granitic but contains small bodies of mafic rocks and remnant metamorphic rocks. The granitic rocks are in several discrete plutons ranging from 183–210 to 80–90 m.y. ago. Uplift and erosion followed the intrusions. Tilting toward the west in the Pliocene culminated in the present eastern height. The western rivers are deeply incised. The root extends to more than 50 km in depth, and was formed during the synclinorium formation and granitic emplacement.—*from* Author's abstract

07377 **Baun, W. L.; Fischer, D. W.** Progress in instrumentation for soft X-ray spectroscopy, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 2: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 557–573, illus., table, 1967.

Instrumentation for the region 5–150A has been greatly improved during the last few years. Secondary excitation-source windows have been made much thinner, high-power windowless X-ray tubes have been developed, primary-electron excitation has been revived, and other forms, such as proton, have been introduced. Organic single crystals have been grown having 2d spacings up to 100A, soap films have been fabricated with 2d spacings up to 165A, and new developments in vacuum deposition show promise. In addition, instruments using dispersion by a grating have been improved greatly. Methods have been improved for use of ultra-thin-windowed flow proportional counters, and new detectors based on magnetic-electron and channel-electron multipliers show promise for use in the 100A region and beyond. Recent work in the Air Force Materials Laboratory is reported, and a general summary of the state-of-the-art is presented.—*from* Authors' abstract

02383 **Bay, Charles A., Jr.** Hydrology, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 404–405, illus., 1968.

In planning for the most efficient use of water resources, some specific factors important to pollution studies, visible and interpretable on color photographs, are: (1) effluent points, seepage areas, and regions of possible contamination not noticeable from the ground; (2) water opacity or transparency, color, local geology, algal growths and bottom or suspended sediments; and (3) flow patterns or currents affecting distribution or concentrations of injected effluents. Two ESSA photographs illustrate these factors, one over western Pennsylvania, an area suffering from acid mine water in the Appalachian coal fields; the other over Cleveland, Ohio, where numerous industrial wastes pollute the watere of Cuyahoga River and Lake Erie. Their layering in the lake waters is easily discerned by color.—GDC

Beebe, B. Warren. *See* Childs, Orlo E. 07349

07452 **Begemann, F.; Wlotzka, F.** Shock effects in the chondrite Ramsdorf [abs.]: Meteoritics, v. 3, no. 3, p. 101–102, 1967.

Bell, P. M. *See* Richardson, S. W. 02442

Bennett, Dale L. *See* Ryall, Alan. 02360

02534 **Bergstrom, Robert E.** Feasibility of subsurface disposal of industrial wastes in Illinois: Illinois Geol. Survey Circ. 426, 18 p., illus., 1968.

Deep-well disposal of liquid wastes is subject to pollution-control regulations and to hydrogeologic conditions, which range from favorable for deep-well disposal in the Illinois Basin, where the section is thick and partly impermeable and ground water highly mineralized below shallow depth, to unfavorable in northern Illinois

where the section is thin, mainly permeable, the ground water fresh to great depth, and the deep aquifers heavily pumped. The most promising reservoirs in southern Illinois are the St. Peter Sandstone, and the Ironton–Galesville and Mt. Simon Sandstones. Other possibilities include sandstones of Pennsylvanian age, Chesterian sandstones and Valmeyeran limestones of Mississippian age, Devonian and Silurian limestones and dolomites, and Ordovician and Cambrian dolomites.—*from* Author's abstract

Berry, L. G. *See* Mason, Brian. 02563

02588 **Bessey, Roy F.** Sediment transport and diffusion—Columbia estuary and entrance—Discussion [of paper 5601 by J. B. Lockett, 1967]: Am. Soc. Civil Engineers Proc., v. 94, paper 6053, Jour. Waterways and Harbors Div., no. WW3, p. 383–384, 1968.

The need for expanding estuarine improvement and control extends not only to aspects stressed in the paper (ibid., v. 93, paper 5601, Jour. Waterways and Harbors Div., no. WW4, p. 167–175, 1967) but to other purposes having to do with maintaining a regimen favorable to the multiple beneficial use of water. Increase in storage capacity upstream, deepening and widening of navigation channels, and industrial and commercial development, especially thermal-power plants, will need to be considered carefully.—ESL

02467 **Beus, Stanley S.; Breed, William J.** A new nautiloid species from the Toroweap Formation in Arizona: Plateau, v. 40, no. 4, p. 128–135, illus., 1968.

Metacoceras thompsoni from the Permian Toroweap Formation of Coconino County, Arizona, is described. Thirteen distinct specimens and some additional fragments are used in defining the species. The distinguishing characteristic is a prominent flange on the ventrolateral shoulder.—Authors' abstract

Bingham, F. T. *See* Sims, J. R. 02264

Bingham, F. T. *See* Sims, J. R. 02265

02598 **Birot, Pierre.** The cycle of erosion in different climates (English edition): Berkeley and Los Angeles, Calif., Univ. California Press, 144 p., illus., translated and revised 1968; originally published in French, 1960.

The book, translated by C. I. Jackson and K. M. Clayton, was originally published in French in Rio de Janeiro, Brazil, based on a series of lectures by the author. The original text was brought up-to-date for this translation, the diagrams were redrawn, and one new one added. The first, and smaller part, of the book, basic processes of the cycle of erosion, is divided into three chapters: weathering of rocks, transport of debris on slopes, and fluvial dynamics. The second part, the influence of different climates on the cycle of erosion, is divided under five climate types: normal, tropical, arid and semi-arid, alternating wet and dry seasons or climates, and periglacial.—ESL

02281 **Black, Robert F.** Geomorphology of Devils Lake area, Wisconsin: Wisconsin Acad. Sci., Arts and Letters Trans. 1967–68, v. 56, p. 117–148, illus. [1968].

The Devils Lake area is mostly a rolling upland dissected by a 500-ft deep, L-shaped gorge, the north end of which is occupied by the moraine-plugged lake. Within and adjacent to the Park, many glacial features are well preserved, and rocks of Cambrian and Precambrian age crop out in bizarre forms. Special features for Park visitors to see are: Devils Lake, the moraines, periglacial and stagnant ice features, drained lakes, potholes, and erratics. In the geologic history, metamorphism and folding of rocks, joints and fracture cleavage made the ancient rocks, particularly the Baraboo Quartzite, susceptible to periglacial frost action in the process of erosion. Silurian chert nodules and boulders, thought to be weathering relicts, may have been transported by early glacial ice.—GDC

02282 **Black, Robert F.; Rubin, Meyer.** Radiocarbon dates of Wisconsin: Wisconsin Acad. Sci., Arts and Letters Trans. 1967–68, v. 56, p. 99–115, illus., tables [1968].

Radiocarbon dating has done more to change the correlation and reconstructed chronology of the Wisconsinan Stage of glaciation in the upper Mississippi Valley than any other method. Discrepancies between the new and classical chronologies are apparent in table 1. In the new chronology, not all events recorded in adjoining states have been recognized in Wisconsin, and vice versa, and some major deposits can only be dated relative to other events. Listed here from Wisconsin, are C-14 dates older than 5,000 years, with significant remarks. Representative dates, shown on a map, fall into natural groups that are correlated with the new chronology: Pre-Rockian, Rockian, Farmdalian, Woodfordian, Twocreekan, Valderan, and post-Valderan. The significance of some of the interpretation of the State's glacial history is discussed.—GDC

02441 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Erichsen Lake, District of Franklin: Canada Geol. Survey Map 1242A, scale 1:253,440, text, 1968.

The eastern half of the Erichsen Lake area is part of the Foxe Basin Lowlands and the western half is the northernmost extension of the Southampton-Melville Upland. Precambrian strata consist of Aphebian granitic and gneissic rocks, Fury and Hecla Formations, and gabbro and diabase. Paleozoic strata—Gallery and Turner Cliffs Formations undivided, and Ship Point and Baillarge Formations—resting unconformably on the Aphebian basement, are relatively thin and poorly exposed, and are generally horizontal and disturbed only by northwesterly trending faults and fractures. Quaternary deposits are drift and unconsolidated sediments.—MCM

02460 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Berlinguet Inlet-Bourassa Bay, District of Franklin: Canada Geol. Survey Map 1241A, scale 1:253,440, text, 1968.

Most of the Berlinguet Inlet-Bourassa Bay area is part of the Boothia-Regent Lowland and is underlain mainly by Paleozoic carbonate rocks. Granitic and gneissic rocks form the Precambrian outcrops; widespread drift cover masks large areas, but some gneissic rocks are exposed. Lower Paleozoic strata—Admiralty Group, Ship Point and Turner Cliffs Formations undivided, and Baillarge and Cape Crauford Formations undivided—rest with pronounced unconformity on Aphebian rocks. In the eastern section, Paleozoic rocks are nearly horizontal and disturbed only by a few southeasterly-trending normal faults; on Brodeur Peninsula they form part of the extensive, arcuate Brodeur homocline which dips gently west to southwest.—MCM

02461 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Arctic Bay-Cape Clarence, District of Franklin: Canada Geol. Survey Map 1237A, scale 1:253,440, text, 1968.

The Arctic Bay-Cape Clarence area forms part of Lancaster Plateau and is characterized by steep cliffs that rise 1,000 feet or more above the sea. Precambrian strata include Adams Sound, Arctic Bay, Society Cliffs, Victor Bay, Strathcona Sound and Elwin Formations, all intruded by gabbro dikes. Paleozoic Admiralty and Brodeur Groups rest with angular unconformity on several Helikian formations. On northwestern Borden Peninsula the Paleozoic rocks are nearly horizontal and are disturbed only by a few normal faults with less than a few hundred feet of dip-slip; on Brodeur Peninsula they form part of an extensive, arcuate structure, the Brodeur homocline, which dips gently northwest.—MCM

02462 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Moffet Inlet Fitzgerald Bay, District of Franklin: Canada Geol. Survey Map 1238A, scale 1:253,440, text, 1968.

The Moffet Inlet-Fitzgerald Bay area is part of the Jones-Lancaster Plateau where elevations exceed 3,000 feet near the small snowfield southwest of the head of Adams Sound. The Precambrian stratigraphic succession ranges from the Aphebian granitic and gneissic rocks through the Helikian Eqalulik and Uluksan Groups; gabbro dikes cut all strata older than the Gallery Formation. Lower Paleozoic strata—Admiralty Group, Ship Point, Baillarge, and Cape Crauford Formations—rest unconformably on the Precambrian rocks. On the east coast of Admiralty Inlet, the Paleozoic

strata are nearly horizontal; on Brodeur Peninsula they form an extensive, arcuate homocline which dips gently west.—MCM

02463 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Agu Bay–Easter Cape, District of Franklin: Canada Geol. Survey Map 1240A, scale 1:253,440, text, 1968.

The eastern half of the Agu Bay–Easter Cape area is part of the Melville Plateau, whereas the western section is part of Boothia Plateau. Precambrian units consist of Aphebian granitic and gneissic rocks, Fury, Hecla, and Autridge Formations, and gabbro sills and dikes. Paleozoic strata—Ship Point, Turner Cliffs, Baillarge, and Cape Crauford Formations—rest with angular unconformity on the Precambrian, mainly Aphebian crystalline rocks. In the eastern area, Paleozoic rocks are nearly horizontal and in the central and western region they form part of the arcuate Brodeur homocline; the two structural belts are separated by a curved fault zone extending from the head of Berlinguet Inlet to Foss Fiord and marked by rivers and elongate lakes.—MCM

07394 **Blanchard, Frank N.; Denahan, Stephen A.** Wavellite-cemented sandstones from northern Florida: Florida Acad. Sci. Quart. Jour., v. 29, no. 4, p. 248–256, illus., 1967.

A number of occurrences of wavellite, similar to that in the Bone Valley Formation, have been found in the Hawthorn Formation in Alachua and Marion Counties. Most wavellite-bearing rocks were in weathered phosphatic argillaceous sandstones. Photomicrographs are included. Thin sections show that wavellite formed by replacement and by filling of pores and fractures. Three types of occurrence are recognized: bedded sandstones, intensely weathered, with cryptocrystalline to microcrystalline wavellite; concretions and nodules in unconsolidated soil or sediments; and macrocrystalline wavellite cementing quartz grains in larger masses with some large pure masses.—ESL

02558 **Blander, Milton.** The topology of phase diagrams of ternary molten salt systems: Chem. Geology, v. 3, no. 1, p. 33–58, illus., tables, 1968.

Phase diagrams of simple ternary reciprocal salt systems are compared with calculations from recent statistical mechanical theories. The major topological features are predicted from the theory. The comparison of theory with experimental phase diagrams gives an insight into the fundamental ionic interactions which lead to particular topological features. A theoretical expression for predicting miscibility gaps in these systems is shown to provide a fundamental explanation of the empirical rules deduced by previous workers. Certain regions of composition in additive (ordinary) ternary systems are analogous to reciprocal systems and the analogy helps in understanding some of the topological properties of these additive ternary systems including miscibility gaps within the ternary composition triangle. [Ternary molten salt systems often have properties similar to important geologic systems.]—Author's abstract

02244 **Bloch, S.; Hales, A. L.** New techniques for the determination of surface wave phase velocities: Seismol. Soc. America Bull., v. 58, no. 3, p. 1021–1034, illus., table, 1968.

A number of new techniques have been developed for determination of phase velocities from digitized seismograms from pairs of stations. One of these techniques is to Fourier analyze the sum (or difference) of the two seismograms after time shifting in steps to correspond to steps in phase velocity. The amplitude of the summed seismogram is a maximum for any particular period when both seismograms are in phase at that period. Another method is to pass both seismograms through a narrow bandpass digital filter centered at various periods and form the cross product of the filtered seismograms, after time shifting. The average of the resultant time series is a maximum when the two signals are in phase. Using these techniques, interstation phase velocities of Rayleigh waves have been determined for the "World Wide Network Standing-Stations" at Pretoria, Bulawayo, and Windhoek.—*from* Authors' abstract

02238 **Bloomquist, Marvin Gaines.** Propagation characteristics of micropulsations [abs.]: Dissert. Abs.,Sec. B, Sci. and Eng., v. 28, no. 10, p. 4124B–4125B, 1968.

Blusson, S. L. *See* Green, L. H. 02585

02521 **Boettcher, A. L.; Wyllie, P. J.** The quartz–coesite transition measured in the presence of a silicate liquid and calibration of piston–cylinder apparatus: Contr. Mineralogy and Petrology, v. 17, no. 3, p. 224–232, illus., table, 1968.

Hydrothermal melting reactions in the system $NaAlSiO_4$–SiO_2–H_2O have been extended into the coesite stability field using piston–cylinder apparatus, and the quartz–coesite transition has been bracketed at 735° (28.0±0.9 Kb) and at 800°C (28.15±0.9 Kb) in the presence of a silicate liquid phase; this provided favorable kinetic conditions. The results agree closely with previous piston–cylinder determinations employing a correction for pressure loss due to friction. Consideration of previous calibration and hysteresis experiments leads to the conclusion that despite its potential utility, the quartz–coesite transition cannot be used confidently as a calibrant for piston–cylinder apparatus until the question of whether or not to apply a friction correction has been resolved.—Authors' abstract

02209 **Boone, Gary M.; Wheeler, E. P., 2d.** Staining for cordierite and feldspars in thin section: Am. Mineralogist, v. 53, nos. 1–2, p. 327–331, 1968.

A modification of the cobaltinitrite–amaranth staining technique, which is outlined in detail, produces a lighter amaranth stain on cordierite than on plagioclase, with sufficient difference so that the minerals are readily distinguished for study of their textural relation and point counts. A trypan blue staining technique, also outlined in detail, may be preferable when only K-rich feldspars and cordierite should be stained, because of the striking contrast thus produced between the blue cordierite and the yellow feldspar.—MEM

02262 **Borchardt, G. A.; Hole, F. D.; Jackson, M. L.** Genesis of layer silicates in representative soils of a glacial landscape of southeastern Wisconsin: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 399–403, illus., tables, 1968.

Mineralogical analyses of soil profiles of a glacial terrain indicate the extent of depositional influence and effect of mineral weathering. The leached upland Lapeer loam (pH 5) contains 20 percent mica and 12 percent kaolinite. Clay in the less leached, neutral Saylesville silt loam at a lower elevation and the calcareous till under the Lapeer solum contain 40 percent mica and 6 percent kaolinite. A relation exists between the pH of the horizon and mica content in soil clay. Variable sand contents of different horizons demonstrate the variable origin of parent material. The Lapeer solum and weathered Peorian loess of Illinois are similar with about 2 K_2O in the clay fractions and a coarse silt/fine silt ratio of 0.7. The dolomitic lacustrine C2 and C4 horizons of Saylesville soil have a vermiculite/mica ratio of 0.18, no sand, and clay minerals nearly identical to those of Lapeer loam.—*from* Authors' abstract

02243 **Bork, Kenneth B.; Perry, T. G.** Bryozoa (Ectoprocta) of Champlainian age (Middle Ordovician) from northwestern Illinois and adjacent parts of Iowa and Wisconsin—Pt. 2, *Bythotrypa, Diplotrypa, Hemiphragma, Heterotrypa, Stigmatella, Eridotrypa,* and *Nicholsonella*: Jour. Paleontology, v. 42, no. 2, p. 337–355, illus., tables, 1968.

Part 2 of this series, concerned with the bryozoan faunas of four Champlainian (Middle Ordovician) limestone units (Mifflin, Quimbys Mill, Guttenberg, and Ion Formations) in northwestern Illinois and adjacent parts of Iowa and Wisconsin, considers representatives of the following genera: *Bythotrypa* Ulrich, *Diplotrypa* Nicholson, *Hemiphragma* Ulrich, *Heterotrypa* Nicholson, *Stigmatella* Ulrich and Bassler, *Eridotrypa* Ulrich, and *Nicholsonella* Ulrich. Except for *Nicholsonella* sp., tables of measurements of taxonomic characters are given for each of the described taxa.—*from* Authors' abstract

07521 **Bostwick, David A.; Nestell, Merlynd K.** Permian Tethyan fusulinid faunas of the northwestern United States, *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 93–102, illus., 1967.

Among the wide variety of Permian fusulinids in northwestern United States and southwestern British Columbia, an abrupt faunal change from non-Tethyan to Tethyan appears to have taken place during the Middle Permian. The genus *Polydiexodina* recently found in Oregon, but reported in other world areas in both types of fauna, is of special interest; of some 15 identified genera, *Nagatoella*, *Yanchienia*, and *Misellina* have not been described from the Western Hemisphere previously. The unusual generic association and possible implication of the limestones present problems of intercontinental correlation. These Oregon faunas, now being described for publication elsewhere, seem to represent the easternmost limit of typical Tethyan faunas in North America.—GDC

02359 **Boucher, Gary; Matumoto, Tosimatu; Oliver Jack.** Localized microearthquakes in the Denali fault zone: Jour. Geophys. Research, v. 73, no. 14, p. 4789–4793, illus., table, 1968.

This study is a preliminary effort to determine the nature of microearthquake activity in the vicinity of the Denali fault in Alaska. Field observations, made using a spacing of seismograph stations of only a few km rather than tens of kms as in other studies, led to the discovery that numerous small events originated in the vicinity of the major faults crossing the area and that similar events did not appear to be generated in significant numbers away from the fault zones. Most of the events originating near the recording sites in the fault zones were so small that they could not be recorded at points only a few km away. Thus, it may be possible to monitor the movements of a particular fault by recording the numerous small events originating in the fault zone itself. Slow movements of a fault could be identified in a rather short period of time in comparison to the numbers of years usually required for geodetic observations.—*from* Authors' conclusions

Boucot, A. J. *See* Johnson, J. G. 02194

Boudette, Eugene L. *See* Ford, Arthur B. 02222

Bouwkamp, Jack G. *See* Rea, Dixon. 02300

02332 **Boyce, Robert E.** Electrical resistivity of modern marine sediments from the Bering Sea: Jour. Geophys. Research, v. 73, no. 14, p. 4759–4766, illus., tables, 1968.

This study is concerned with the relationships between electrical resistivity and the bulk physical properties of sea-floor sediments. Electrical resistivity was measured in gravity-cored unconsolidated sediments from the Bering Sea. Resistivity ranged from 29.1 to 71.0 ohm cm at 25°C and irregularly increased 11 ohm cm in the first meter below the sediment surface, principally because of porosity changes. In situ resistivity may be greater than these laboratory values by a factor of 2 or 3. The formation factor F, which is the ratio of sediment resistivity to interstitial water resistivity, ranged from 1.57 to 3.70 and was related to porosity ϕ and wet bulk density p by the following expressions: $F = 1.30\phi^{-1.45}$ and $F = 1.12p^{1.72}$ with errors of ± 15 and ± 10 percent. Within certain limits resistivity may be used to estimate other physical properties of the sediment.—Author's abstract

07450 **Bradley, C. L.; Sandberg, H. J.; DeMatteo, J.** Identification of deflection of the vertical using an inertial system, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 205–216, illus., tables, 1967.

A graphical method is presented of identifying the parameters of a gravity deflection profile of the form $a(1-\cos \omega_{phi} t)$, where a = coefficient gravity deflection waveform, and ω_{phi} = frequency of gravity deflection input, by observation of inertial system position error responses. The method does not give the absolute deflection with respect to the reference ellipsoid but only the relative change from one geographic position to another. The effectiveness of the graphical recovery technique diminishes

with increase in noise, and in the presence of noise is a best indicator of 'large' gravity deflections. If the wavelength of the gravity deflection is desired, the ship's velocity must be known.—VSN

02491 **Branson, Carl C.** Everett Carpenter, 1884–1968: Oklahoma Geology Notes, v. 28, no. 3, p. 110–111, portrait, 1968.

02492 **Branson, Carl C.** Atoka series of the Oklahoma region [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 115, 1968.

07514 **Branson, Carl C.** (compiler). Surface mapping, 1901–1966, Map I–B—Index to geologic mapping in Oklahoma, Supp. 2: Norman, Okla., Oklahoma Geol Survey, scale about 1 in. to 16 mi., 1967.

Breed, William J. *See* Beus, Stanley S. 02467

Brett, George W. *See* Weld, Betsy A. 02593

02242 **Bridgwater, D.; Gormsen, K.** Precambrian rocks of the Amgmagssalik area, East Greenland, *in* Report of activities, 1967: Grönlands Geol. Undersögelse Rap. 15, p. 61–71, illus., 1968.

Rocks are predominantly feldspathic gneisses with intercalated migmatitic gneisses with amphibolite facies assemblages. The gneisses contain many bodies of metamorphosed mafic and ultramafic rocks, some interlayered. Gneisses and metasediments involved in local high-grade metamorphism are shown as the charnockite suite. The youngest plutonic rocks constitute a suite of calcalkaline norites, diorites, and granites. The last major plutonic event, dated at 1600 to 1800 m.y., affected all rocks in the area. Several generations of mafic dikes, perhaps Tertiary, cut the Precambrian rocks. The structural pattern is dominantly recumbent isoclinal folds and nappes with some overthrusting; this east-west pattern is modified by folding about a north-south axis.—ESL

02493 **Briggs, Garrett.** Geology of the Lynn Mountain syncline, Ouachita Mountains, LeFlore County, Oklahoma [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 115–116, 1968.

02530 **Brock, Vernon E.; Chamberlain, Theodore C.** A geological and ecological reconnaissance off western Oahu, Hawaii, principally by means of the research submarine "Asherah": Pacific Sci., v. 22, no. 3, p. 373–394, illus., tables, 1968.

Bottom topography was surveyed with a precision echo sounding recorder. Photographic bottom surveys were also made, and some dredging and trawling one. Dominant features were a series of wave-cut, sand-covered terraces, the major ones being: the upper, terminating at about 60 m depth, an intermediate one from 70–120 m, and a deep one beginning at 180 m or deeper. Littoral sand movement is southerly between Kaena and Kepuhi Points, with a substantial offshore movement, about 10,000 cu yds of calcareous sand being deposited on inner portions of the deep terrace. Distribution patterns of fish and other life associated with the terraces was studied also.—ESL

Broecker, Wallace. *See* Takahashi, Taro. 02536

02507 **Broms, Allan.** Thus life began: Garden City, N.Y., Doubleday and Co., 326 p., illus., 1968.

The author follows the circuitous historical route leading from early theories of spontaneous generation to awareness of cell differentiation, and at the same time traces the evolutionary route from amoeba to man.—ESL

02444 **Brookins, Douglas G.** Rb-Sr age of the Ammonoosuc Volcanics, New England: Am. Jour. Sci., v. 266, no. 7, p. 605–608, illus., table, 1968.

The Rb-Sr isotopic age of the Ammonoosuc Volcanics in New England has been determined as 460±15 m.y. with an initial Sr (87/86) ratio of 0.706±0.001. This

isotopic age is consistent with the Middle Ordovician age to which the Ammonoosuc Volcanics are assigned on geologic evidence.—Author's abstract

02365 **Brooks, C.** Relationship between feldspar alteration and the precise post crystallization movement of rubidium and strontium isotopes in a granite: Jour. Geophys. Research, v. 73, no. 14, p. 4751–4757, illus., tables, 1968.

Preparation of high-purity plagioclase separates from a coarse-grained granite (Heemskirk granite, western Tasmania) allows, for the first time, the exact delineation of the amounts of radiogenic Sr, Rb, and common Sr migrating between cogenetic K-feldspar and plagioclase in a typical post-crystallization granite environment. It is found that the calculated present-day composition of the unaltered K-feldspar in this granite occupies a surprising position on the reference isochron. The normal interpretation of discordant K-feldspars in terms of radiogenic Sr loss only must now be viewed as a gross simplification of the isotopic migration pattern. The larger amounts of isotopes recognized to be involved in this migration must also be taken as firm indication of the possibility of open system total-rock behavior in granites displaying feldspar alteration.—*from* Author's abstract

02518 **Brown, E. H.** The Si^{+4} content of natural phengites—A discussion [of paper by Bruce Velde, 1965]: Contr. Mineralogy and Petrology, v. 17, no. 1, p. 78–81, illus., 1968.

In comparing reports on the silica content of phengitic micas from various areas of the world (including Maine and Vermont), this writer disputes Velde's hypothesis (ibid., v. 14, 1965) and provides new evidence showing that rock composition is an important control of Si-content in phengites and muscovites, and concludes that the maximum amount of Si stable in phengites decreases with increased metamorphic grade but that at any specific grade the actual Si content can vary considerably (up to the maximum amount) and is dependent on the host rock composition.—GDC

Brown, I. C. *See* Geological Survey of Canada Officers, 07504

07505 **Brown, I. C.** Intrduction, Chap. 1 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 1–29 illus., tables, geol. map, 1967.

A summary is attempted in general terms of the present knowledge of the behavior of ground water, which in Canada contributes about ten percent of the municipal water supply in communities of over 1,000 population, and more to individual homes, and industrial and irrigation supplies. Briefly reviewed are: the history of ground-water studies in Canada, definitions of commonly used terms, the hydrologic cycle, ground-water fluctuations and flow systems, geological materials, chemistry of ground water, hydrogeological regions, and basin studies. In pocket is a generalized map of the major hydrogeological regions of Canada.—GDC

07421 **Brown, Richard.** A seismic refraction study of Michigan's Upper Peninsula: Compass, v. 45, no. 1, p. 33–39, illus., tables, 1967.

Seismic refraction profiling was carried out at nine stations in the west half of the Upper Peninsula of Michigan and two in northeastern Wisconsin. Three major geological provinces intersect in the area: the Wisconsin arch, the Keweenawan basin, and the Michigan basin. In the first, Precambrian rocks are metamorphosed to greenstone, slate, and quartzite; in the second, Keweenawan and Cambrian rocks occur; and in the Michigan basin, rocks range from Cambrian to Pennsylvanian. The seismic velocities confirm the rock types described by well logs and mine information. The Gibbs City area needs further studies as results are not consistent with the geologic map. Dip and depth information also seem consistent. It is concluded that this method can be used to correlate geology of this area.—ESL

02535 **Brown, Seward R.** Bacterial carotenoids from freshwater sediments: Limnology and Oceanography, v. 13, no. 2, p. 233–241, illus., tables, 1968.

Sediment cores from Little Round Lake, Ontario, contain a band extending from 200 to 225 cm beneath the mud–water interface that is rich in bacterial carotenoids, associated with algal carotenoids, chlorophyll derivatives and bacteriopheophytin. *Cis–trans* isomerization of the compounds appears to have taken place in the sediments. Three stereoisomers of spheroidenone and two of spheroidene were found. The isomerization process may have geochemical implications. No morphologically distinguishable remains of the organisms that produced the pigments could be found. Relative proportions of three fossil xanthophylls are in close agreement with those found in senescent cultures of *Rhodopseudomonas spheroides*, when grown under aerobic conditions. Identification of the organism is attempted, based on comparison of pigment distribution in the Athiorhodaceae with that of fossil pigments from the sediment.—*from* Author's abstract

Browne, Ruth G. *See* Pohl, E. Robert. 02188

Brueckner, W. D. *See* Lilly, Hugh D. 07409

02485 **Brugger, Wayne E.** Potential recharge of abandoned sand pits, Lincoln wellfield, Ashland, Nebraska [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 19, 1968.

Brune, J. N. *See* Allen, C. R. 02580

Brune, James N. *See* Wyss, Max. 02335

07391 **Bryant, William R.; Cernock, Paul; Morelock, Jack.** Shear strength and consolidation characteristics of marine sediments from the western Gulf of Mexico, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 41–62, illus., table, 1967.

Sediments from the Texas and Mexican continental shelf and slope and the Sigsbee abyssal plain in the Gulf of Mexico were tested to determine their shear strength and consolidation characteristics. Graphic determination of preconsolidation by the Casagrande method indicated that the continental slope and shelf sediments were overconsolidated, the deltaic sample was underconsolidated, and the abyssal plain samples were normally consolidated to slightly underconsolidated. The rate and mode of deposition and chemical alteration of carbonate and volcanic material with subsequent cementation are the variables most closely associated with observed consolidation characteristics. The role of incipient cementation by chemical alteration of carbonate and volcanic material is an important factor controlling the geotechnical characteristics of marine sediments.—KAS

07392 **Buchan, S.; Dewes, F. C. D.; McCann, D. M.; Smith, D. Taylor.** Measurements of the acoustic and geotechnical properties of marine sediment cores, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 65–92, illus., tables, 1967.

Sediment cores collected by a hydroplastic corer in the North Atlantic are being subjected to a wide range of acoustic and mechanical measurements. The following conclusions can be drawn: (1) Shear strength has a positive correlation with median diameter, carbonate content, and wet density. (2) Shear strength has a negative correlation with moisture content, porosity and plasticity index. (3) Sensitivity has a tentative negative correlation with carbonate content. (4) The coefficient of consolidation has a positive correlation with the sand fraction. (5) Sound velocity has a positive correlation with shear strength. (6) Sound attenuation increases with frequency increase and has a negative correlation with plasticity index. (7) Sound attenuation has a positive correlation with carbonate content and sand fraction.—KAS

07453 **Buchheit, R. D.; McCall, J. L.; Henderson, E. P.** Some metallographic observations on the Tishomingo–Oklahoma meteorite [abs.]: Meteoritics, v. 3, no. 3, p. 103, 1967.

Buffington, E. C. *See* Scholl, D. W. 02284

07477 **Bull, Colin; Marangunic, Cedomir.** The earthquake-induced slide on the Sherman Glacier, south-central Alaska, and its glaciological effects, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 395–408, illus., 1967.

The March 27, 1964 earthquake dislodged 10^7 m^3 of rock on to a tributary of Sherman Glacier. The debris covered about 8 km^2 of the ablation zones of the two glaciers with a layer 1–3 m thick. Generation of the slide was favored by slightly metamorphosed and fractured strata overlain by massive quartzites; bedding was steeply dipping and nearly parallel to the original surface of the ridge. The debris layer has reduced annual ablation to almost zero over more than half of the ablation zone, and the mass balance of the glacier and its tributaries has been changed from slightly negative to positive. Some measurements of surface ice velocity and strain, made in 1965, appear anomalous and may indicate that the glacier was already responding to the change in regime.—*from* Authors' abstract

02258 **Bulman, O. M. B.** The mode of development of *Isograptus manubriatus* (T. S. Hall): Geol. Mag., v. 105, no. 3, p. 211–215, illus., 1968.

The reverse aspect of the proximal end of *I. manubriatus* is described and its relation to the mode of development of some early biserial forms is briefly discussed. Two new names descriptive of types of development are proposed.—Author's abstract

07454 **Bunch, T. E.** Weekeroo Station—A siderophyre [abs.]: Meteoritics, v. 3, no. 3, p. 103–104, 1967.

Bundy, F. P. *See* Strong, H. M. 07441

Buol, S. W. *See* Dolman, J. D. 02268

Burbridge, P. P. *See* Felix, C. J. 02348

07342 **Burg, K. E.** Marine geodetic problems of industry and commerce, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 55–60, illus., 1967.

The scientific investigation of marine phenomena becomes more meaningful if locations of measurements are accurately known. Position-fixing is a basic requirement in every application of marine geodesy. The seismic method of exploration at sea for petroleum and shipborne gravity systems are examined as examples of the application of marine geodesy.—VSN

07473 **Burkhalter, Philip G.; Campbell, William J.** Comparison of detectors for isotopic X-ray analyzers, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 393–423, illus., tables, 1967.

Isotopic X-ray analyzers for use as drill-hole probes and process monitors are being developed and evaluated as part of the Bureau of Mines Heavy Metals Program. Optimization of the X-ray detector is required to analyze low grade gold and silver ores, using energy dispersion techniques with isotopic X-ray excitation. The following properties of gas, scintillation, and semiconductor X-ray detectors are compared: detection efficiency, pulse resolution, intensity and energy linearity, stability, size, ruggedness, and cost. Scintillation detectors have satisfactory overall detection capabilities except for poor pulse resolution. Gas proportional detectors are excellent low energy X-ray detectors except space charge results in pulse shifts with intensity. Semiconductor detectors are attractive because their sharp pulse resolution (less than one kev) allows multi-element determination by electronic pulse analysis.—Authors' abstract

07321 **Buseck, Peter R.** New iron-nickel phosphide mineral [abs.]: Meteoritics, v. 3, no. 3, p. 104, 1967.

02364 **Byerlee, James D.** Brittle-ductile transition in rocks: Jour. Geophys. Research, v. 73, no. 14, p. 4741–4750, illus., table, 1968.

The deformational characteristics of two limestones, one gabbro, and one dunite have been investigated as a function of confining pressure. It was found that friction of these rocks and friction of granite and serpentinite studied elsewhere are nearly identical and that the brittle–ductile transition pressure is simply the pressure at which the stress required to form a fault is equal to the stress required to cause sliding on the fault. The transition pressure is higher in extension than it is in compression. This difference occurs because the frictional shear stress required to cause sliding is determined not by confining pressure but by the principal stresses and the angle of the fault. For the same frictional shear stress on a fault surface, the confining pressure is much higher in extension than it is in compression.—Author's abstract

02333 **Cadle, Richard D.; Frank, Evelyn R.** Particles in the fume from the 1967 Kilauea eruption: Jour. Geophys. Research, v. 73, no. 14, p. 4780–4783, illus., 1968.

During the 1967 eruption of Halemaumau crater, samples of particles in the eruption fume were collected at various points around the crater's edge. Examination of the samples with an optical microscope showed that the particles were largely hygroscopic, water-miscible droplets, plus a few mainly acicular, solid particles. Two types of acicular particles were present. Some were water-soluble and optically isotropic, and others were optically anisotropic. It is concluded that the particles collected from the fume were largely (>75 percent) dilute sulfuric acid droplets containing some cations in addition to H^+, such as NH_4^{++} and Ca^{++}. Particles of ammonium bisulfate, ammonium sulfate, ammonium chloride, sulfur, and calcium sulfate were present also.—KAS

02452 **Cady, Wallace M.** Tectonic setting and mechanism of the Taconic slide: Am. Jour. Sci., v. 266, no. 7, p. 563–578, illus., 1968.

The Taconic klippe, composed of Cambrian and Lower and Middle Ordovician eugeosynclinal rocks, rests upon miogeosynclinal rocks of the same age; it is a product of gravity sliding from the east, from a rising geanticline, now the site of a gravity high. Fluids were expelled during metamorphism, from eugeosynclinal rocks on the east side of the geanticline and migrated westward and served as the pore-pressure mechanism for the sliding which occurred when the relief became sufficient to encourage the sliding. Sliding possibly took place in a similar way at other places in the Appalachian–Caledonian and also the Alpine regions as suggested by their partly comparable tectonic relations.—*from* Author's abstract

02317 **Cahoon, Elizabeth J.** Palynology of the Inyan Kara Group of South Dakota [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 724–725, 1968.

Caldwell, A. C. *See* Rehm, G. W. 02236

07397 **California Dept. Water Resources.** San Joaquin County ground water investigation: California Dept. Water Resources Bull. 146, 177 p., illus., tables, 1967.

The more than 745,000 acre-feet pumped annually is almost the sole source of water. This investigation was undertaken because of marked changes in ground-water quality locally. Aquifers include the Mehrten, Laguna, Tulare, and Victor Formations, as well as flood-basin, alluvial fan, and stream channel deposits. No barriers to lateral movement of water were found, but faults on the west side may bring in waters high in boron from below. A hydrologic balance calculated for 1950–64 shows a mean annual overdraft of 123,000 acre-feet by 1964; the water table has dropped 40–60 feet near cities, and poor-quality water is moving east from the delta. In the Stockton area pumping will have to be reduced to correct the quality. Plates, showing the areal geology, three cross sections, and four isopach maps of sand thickness, are included.—ESL

07485 **California Dept. Water Resources.** Mojave River ground water basins investigation: California Dept. Water Resources Bull. 84, 151 p., illus., tables, geol. map, 1967.

In this part of the Mojave Desert in western San Bernardino County, three major faults impede ground-water movement; southwest of each, water levels are up to 60 feet higher. Six storage basins receive percolating Mojave River water; a seventh, Lucerne Basin, receives subsurface inflow from bordering mountains. Changes in storage over 25 years were compared with annual water supply; deficiency met by pumping, with urban growth and drought needs supplemental import. Wide variation in water quality and mineral character is related to source, nature of 11 Quaternary aquifer units, and use of water. Detailed data are tabulated; figures and plates show geology, hydrographic units, land use, and water-level changes.—GDC

07488 **California Dept. Water Resources.** Evaluation of ground water resources, South Bay—App. A, Geology: California Dept. Water Resources Bull. 118-1, 153 p., illus., tables, geol. map, 1967.

The southern part of the San Francisco Bay area is described in this appendix; the geologic history and physiography are reviewed, and a detailed discussion of the latter appears as Attachment 2. Formations include Jurassic to Pliocene nonwater-bearing rocks, and the water-bearing Pliocene-Pleistocene Santa Clara Formation and Quaternary alluvium. There are three main fault systems. Bedrock surface is shown by contours on the surficial geologic map. Brief sections describe collection and analysis of basic data, geophysical surveys, test hole drilling, and installation of piezometers. More detail on the seismic and gravity surveys is contained in Attachment 3. The character of aquifers and aquicludes for the three ground-water areas and their subareas, and possibilities for recharge and effects of structural features are discussed. Physiographic and gravity maps, and a magnetic map of the Coyote Hills area accompany the report.—ESL

02199 **Campbell, F. E.; Roeder, P.** The stability of olivine and pyroxene in the Ni-Mg-Si-O system: Am. Mineralogist, v. 53, nos. 1-2, p. 257-268, illus., tables, 1968.

Phase relations were investigated at 1300°-1500°C at controlled oxygen fugacities. The free energy of formation of nickel oxide varied from -24.4 Kcal per mole at 1300°C to -19.9 Kcal per mole at 1500°C. The free energy change for the reaction $2Ni + SiO_2 + O_2 = Ni_2SiO_4$ was determined at five temperatures and varied from -49.3 Kcal per mole at 1300°C to -40.1 Kcal per mole at 1500°C. The ideality of the magnesium-nickel olivine solid solution was measured and the close approach of the activity coefficients to unity (the maximum activity coefficient is 1.18) indicates a close approach to ideal behaviour. The oxygen fugacity for the univariant equilibrium between the most nickel rich (13 mole percent $NiSO_3$) pyroxene, olivine, cristobalite, metal and vapor at 1400°C is $10^{-7.45}$ atm.—*from* Author's abstract

02587 **Campbell, R. B.** Geology, Canoe River, British Columbia: Canada Geol. Survey Prelim. Ser. Map 15-1967, scale 1:253,440, sections, text, 1968.

Strata in the Rocky Mountain section of the Canoe River area range from metamorphic rocks of unknown age through Precambrian Miette Group, Cambrian Gog Group, and Quaternary deposits. In the Cariboo, Monashee, and Selkirk Mountains, metamorphic rocks are overlain by Precambrian and Cambrian strata. Biotite granodiorite cuts across and warps structures in the stratified rocks; muscovite-biotite granite transects structures of surrounding rocks. Tertiary basaltic flows occupy much of the Clearwater River valley; a second group of basaltic effusives are modified by glacial erosion and hence are Pleistocene or older. Youngest volcanic rocks, basaltic cinder cones and lava flows, are postglacial. The northern of two regional structures is cut off by faults subparallel to the Rocky Mountain Trench. No exploitable mineral deposits have been discovered.—MCM

Campbell, William J. *See* Burkhalter, Philip G. 07473

02197 **Canis, Wayne F.** Conodonts and biostratigraphy of the Lower Mississippian of Missouri: Jour. Paleontology, v. 42, no. 2, p. 525-555, illus., tables, 1968.

Eighteen conodont genera which comprise fifty-six species from Lower Mississippian (Kinderhookian) strata of Missouri are described. *Siphonodella sulcata* (Huddle), *S. duplicata* (Branson and Mehl), *S. quadruplicata* (Branson and Mehl), and *S.*

isosticha (Cooper) are the most useful species in establishing areal correlations among the Hannibal Shale, Bachelor Formation, Chouteau Limestone, Sedalia Dolomite, and Northview Shale.—*from* Author's abstract

Canis, Wayne F. *See* Conkin, James E. 02523

02511 **Carmichael, I. S. E.; Hampel, J.; Jack, R. N.** Analytical data on the U.S.G.S. standard rocks: Chem. Geology, v. 3, no. 1, p. 59–64, tables, 1968.

The six new U.S. Geological Survey standard rocks together with G–1 and W–1 have been partially analysed using a combination of wet chemical techniques and X-ray fluorescence, and the results of 36 determinations for each rock are tabulated.—Authors' abstract

Carozzi, A. V. *See* Lacey, J. E. 07399

02565 **Carpenter, John R.** Apparent retrograde metamorphism—Another example of the influence of structural deformation on metamorphic differentiation: Contr. Mineralogy and Petrology, v. 17, no. 3, p. 173–186, illus., 1968.

A model is proposed according to which pressure gradients brought on by folding during regional metamorphism cause migration of water to low pressure fold crests, and ultimately the formation of a more hydrous assemblage. Thus several mineral assemblages, each characteristic of a different metamorphic facies, can be formed during the same event, under the same pressure-temperature conditions. The paragenetic relationships between three mineral assemblages in a metamorphosed basalt flow, the Moppin Schist, Las Tablas quadrangle, New Mexico, are used as an example. During regional metamorphism the basalt was recrystallized to hornblende-, oligoclase-, and biotite-bearing assemblages. Folding late in the course of regional metamorphism brought about destruction of pre-existing assemblages in the fold crests and formation of a more hydrous chlorite and albite assemblage.—ESL

Carpenter, Robert A. *See* Jones, W. Barclay. 07379

07507 **Carr, P. A.** Appalachian hydrogeological region, Chap. 3 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 65–97, illus., tables, geol. maps, 1967.

To describe relative quantity and quality of ground water in the rocks of Canada's Appalachian area, published and available unpublished reports are summarized. This hydrogeological region includes that part of Quebec south of Logan fault, as well as the Magdalen Islands, New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland. In general it receives more rainfall than others, but quantity of ground water available is not large, for the rocks are not very permeable; bedrock is mainly igneous and metamorphic (pre-Carboniferous in age), and sedimentary (Carboniferous to Triassic). Sand and gravel deposits are small. Ground water for the most part moves through discontinuities in rocks. Hydrostratigraphic units of the Maritime Provinces are mapped; lack of data precludes poorly drained Newfoundland and the rugged Quebec area.—GDC

Carroll, Roderick D. *See* Scott, James H. 07347

02227 **Carstens, Harald.** Kinetic considerations in the genesis of growth twinning—A discussion [of paper by T. W. Donnelly, 1967]: Am. Mineralogist, v. 53, nos. 1–2, p. 342–344, 1968.

The author suggests that in addition to kinetic factors suggested by Donnelly (ibid., v. 52, p. 1–12, 1967) in the growth of twinned crystals, energy factors may be important in the nucleation of the crystal.—JSH

02377 **Carter, William D.** Some uses of space photography in Earth resources surveys, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 398–399, illus., 1968.

An example of Gemini IX space photography demonstrates strikingly the kinds of information that may be obtained by looking at Earth from space, highly useful for a variety of scientific disciplines. By topography and by color, geologists can distinguish between gross rock types, and can sketch major regional structures that have distorted the rocks and broken the surface and study their relationships to mineral belts and mineral districts in the area. Such features are traced on an illustrative photograph.—GDC

02525 **Carver, Robert E.** The piezometric surface of the Coastal Plain aquifer in Georgia, estimates of original elevation and long-term decline: Southeastern Geology, v. 9, no. 2, p. 87–99, illus., table, 1968.

Principal ground-water source is the artesian Coastal Plain aquifer of Eocene–Miocene limestones capped by impervious Miocene sediments. Heavy pumping has resulted in deep cones of depression in the piezometric surface around centers of population and industry. Reports on artesian wells (1898, 1908, 1915) provided data which were used to construct a map of the original piezometric surface of the aquifer. Comparison of this map with a map of the surface in 1942 and more recent data indicates that between 1880–1966 average total pressure decline for 31 wells was 34 feet. Average decline does not reflect distribution of the pressure decline, which was 35 feet in the coastal area and 75 feet in the artesian-pressure escarpment (Tifton area) and on the order of 10 feet near the original 300 ft contour. Since the long-term effect of heavy pumping has been far-reaching, a more extensive network of observation wells is needed to monitor aquifer pressures.—*from* Author's abstract

07466 **Castro, M. J.** Geology and oil potential of the area westerly of San Juan Bautista, California, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calf.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 81–86, illus., geol. map, 1967.

A narrow structural trough containing over 6,000 feet of lower Tertiary sediments trends northwesterly from San Juan Bautista for 30 mi. Bounded on the east by the San Andreas fault, and on the west by the Vergeles, it never exceeds over four miles in width. Granitic rocks outcrop along both sides. In the trough, the Eocene–Oligocene San Lorenzo Formation, and the Oligocene Vaqueros Formation are topped with volcanic flows and sandstones. Vertical movement on the Vergeles fault must have occurred contemporaneously with deposition but ended before the Pliocene. Another set of faults occurs in the Tertiary sediments. The southwest portion of the trough is the most promising for oil and gas exploration; test wells have had good shows.—ESL

07405 **Causey, L. V.; Scott, J. C.; Newton, J. G.** Geologic map of Houston County, Alabama: Alabama Geol. Survey Map 58, scale about 1 in. to 1 mi., text, 1967.

Geologic units of sedimentary origin and cropping out in Houston County are, from oldest to youngest: Tertiary Tallahatta and Lisbon Formations, Ocala Limestone and Moodys Branch Formation undifferentiated, and residuum; and Quaternary alluvium and terrace deposits. All Tertiary units that crop out or underlie the area will yield sufficient water for domestic use; principal sources are Clayton and Nanafalia Formations, Tuscahoma Sand, Hatchetigbee, Tallahatta, Lisbon, and Moodys Branch Formations, and Ocala Limestone in which wells will produce 1 mgd or more. Limonite, occurring near the base of the residuum in some areas may be of future economic importance. The Lisbon Formation, residuum, alluvium, and terrace deposits are potential sources of sand and gravel. Clay from Chattahoochee River alluvium is used for brick manufacture.—MCM

Cernock, Paul. *See* Bryant, William R. 07391

02430 **Cervione, Michael A., Jr.; Grossman, Irving G.; Thomas, Chester E., Jr.** Hydrogeologic data for the lower Thames and southeastern coastal river basins, Connecticut: Connecticut Water Resources Bull. 16, 65 p., illus., tables, 1968.

This supplemental report presents hydrologic and geologic data collected from 1963 to 1965 by the U.S. Geological Survey in a cooperative investigation of about 440

sq mi in southeastern Connecticut, and 5 sq mi along the Rhode Island border. The data include ground-water records of about 740 wells, records of 5 springs, and logs of 229 wells and test holes, as well as chemical analyses of the water from springs and wells, streams, lakes and reservoirs. Locations of data-collection sites are shown on map in pocket.—GDC

Chamberlain, Theodore C. *See* Brock, Vernon E. 02530

02299 **Chandra, Umesh.** Theory of head waves for focal mechanism studies: Seismol. Soc. America Bull., v. 58, no. 3, p. 993–1019, illus., table, 1968.

Haskell's result for the displacement due to a single-couple source of arbitrary orientation in a homogeneous, isotropic, perfectly elastic infinite space has been used to obtain the P, SV and SH wave potentials in a cylindrical coordinate system. Approximate far field solutions for the components of displacement of the free surface due to $P_1P_2P_1$, $(S_1S_2S)_{sv}$, $(S_1S_2S_1)_{sh}$ headwave arrivals for a single- and double-couple source in the upper medium of a layer over a half-space have been obtained. Examples are given for the azimuthal radiation pattern for $P_1P_2P_1$ headwave and horizontal radial, crossradial, and vertical $S_1S_2S_1$ headwave displacement components for a suitably chosen, single-layered Earth model.—*from* Author's abstract

Chaplin, James R. *See* Pohl, E. Robert. 02188

07509 **Charron, J. E.** Canadian Shield hydrogeological region, Chap. 5 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 120–130, illus., tables, 1967.

This region, in the southern Canadian Shield in Ontario and Quebec, has a humid climate in contrast to the subarctic region of permafrost on the north. No complete well inventory or ground-water studies have been published, so available data is scanty and descriptions general. Over 90 percent of the region is mantled by unconsolidated deposits which are not as well mapped as the Precambrian bedrock. Surficial waters satisfy most requirements at present. The complexly deformed crystalline rocks can be considered poor aquifers, surficial moraines and outwash deposits would seem to be the best. Except for base metal mining areas, ground water is potable; it should be of bicarbonate type, with very constant chemical content.—GDC

Chesters, G. *See* Petersen, G. W. 02288

07349 **Childs, Orlo E.; Beebe, B. Warren.** (editors). Kordil'ery Ameriki—Simpozium [Russian translation]: Moscow, Izdatel'stvo "Mir", 241 p., illus., 1967; originally published in English, 1963.

This is a Russian translation of "Backbone of the Americas—Tectonic history from pole to pole, a symposium": Am. Assoc. Petroleum Geologists Mem. 2, 320 p., illus., 1963.—VSN

Christ, C. L. *See* Truesdell, A. H. 02547

Church, C. C. *See* Rogers, T. H. 07387

Clabaugh, S. E. *See* Wilson, John Andrew. 02443

02184 **Clark, David L.; Muller, Klaus J.** The basal opening of conodonts: Jour. Paleontology, v. 42, no. 2, p. 561–582, illus., tables, 1968.

Observations on a number of different species, which range in age from Cambrian to Triassic, confirm that conodonts have at least two kinds of basal openings. The primitive type is a *basal cavity* which increased in size as the specimen grew larger. The second variety is defined as a pit; its size was relatively constant after the initial stages of growth, although the total size of the specimen bearing it may have increased several times.—*from* Authors' summary

02279 **Clark, G. Michael.** Sorted patterned ground—New Appalachian localities south of the glacial border: Science, v. 161, no. 3839, p. 355–356, illus., 1968.

Sorted stripes, nets, and polygons in the Appalachians of Pennsylvania, West Virginia, and Virginia display patterns and stone orientations visibly similar to those of ground patterned under current cold climates. Larger forms appear inactive or fossil and may provide data on the paleoclimate and slope stability.—Author's abstract

Clark, M. M. *See* Allen, C. R. 02580

Clark, Mary Gilman. *See* Shaw, Alan B. 02205

02206 **Clark, Mary Gilman; Shaw, Alan B.** Paleontology of northwestern Vermont—[Pt.] 15, Trilobites of the Upper Cambrian Gorge Formation (lower part of Bed 3): Jour. Paleontology, v. 42, no. 2, p. 382–396, illus., tables, 1968.

The nonagnostidean trilobite fauna of the lower part of Bed 3 of the type section of the Upper Cambrian Gorge Formation is assignable to the *Dunderbergia* Zone which has not previously been recognized in Vermont. Eleven species and one subspecies are formally recognized; three cranidia and three pygidia are unassigned. A new family, Phoreotropididae, is erected; two new genera, *Bigranulella* and *Punctaspis*, are recognized; nine new species, *Paraphoreotropis vermontensis, Pterocephalops tuberculineata, Olenaspella angularis, Dunderbergia directifrons, Bellaspis longifrons, Quebecaspis hemispherica, Bigranulella latigenae, Oligometopus vermontensis, and Punctaspis crassimargo*, are established; and *Quebecaspis marylandica tuberculata* is erected as a new subspecies.—Authors' abstract

02221 **Clarke, A. L.; Graham, E. R.** Zinc diffusion and distribution coefficients in soil as affected by soil texture, zinc concentration and pH: Soil Sci., v. 105, no. 6, p. 409–418, illus., 1968.

The diffusion of zinc increased five-fold in loam (pH 5.0) when the concentration of nonradioactive zinc added was raised from 0.5 to 4.3 percent of the soil's cation exchange capacity (CEC), and similarly in sand and clay. The preferential adsorption of zinc by soil colloids at low zinc concentrations is inferred. The precipitation of immobile zinc hydroxide and calcium zincate at higher pH values is likely.—JWH

Clarke, R. T. *See* Gibson, L. B. 02187

02350 **Clendening, J. A.; Nygreen, P. W.** A new spore genus from the Upper Pennsylvanian of Kansas [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723–724, 1968.

02213 **Clifford, Paul M.** Flood basalts, dike swarms and sub-crustal flow: Canadian Jour. Earth Sci., v. 5, no. 1, p. 93–96, illus., 1968.

A review of published data on flood basalts and diabase dike swarms suggests that they are related in origin, typically being developed in zones of crustal tension induced by sub-crustal flow. Perhaps, therefore, these basaltic effusions may be used to map convective cells in the mantle for various periods during geologic time. The inferred pattern of sub-crustal movements, particularly for the southern continents, is seen to be complicated, both temporally and spatially, and is strongly suggestive of unsteady motion. Dikes of the Canadian Shield permit inferences about the site of convective cells back to 2,150million years.—Author's abstract

02399 **Coates, M. E.** Geology of Stevens-Kagiano Lake area, District of Thunder Bay: Ontario Dept. Mines Geol. Rept. 68, 22 p., illus., geol. maps, 1968.

This report describes the geology, structure, and mineral deposits of the Stevens-Kagiano Lake area, District of Thunder Bay. The area lies northeast of the Manitouwadge mining camp. The area is underlain by Precambrian rocks, most of which are metasedimentary or metavolcanic migmatites. Several belts of metasediments and numerous granitic bodies have been outlined. The country rocks

have been intruded by gabbro, syenite, granite, and diabase. Folding has taken place about northeast-trending axes. Many major linear features have been noted. Several small copper showings are found within the area. Diabase dikes exercise a structural control for some of the occurrences while others are located above strike shears in the migmatite. Pyrrhotite and chalcopyrite are the most common sulphide minerals.—Author's abstract

07426 **Cohenour, R. E.** History of uranium and development of Colorado Plateau ores with notes on uranium production in Utah, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 12–22, illus., tables, 1967.

Early mining in the region was for the radium associated with the uranium mineralization; later, vanadium was actively mined from the area also. After 1944, the area became a uranium producer. Tables show the production from the various districts over the years. No geological data are included.—HRC

07432 **Cohenour, R. E.** Selected references and papers pertinent to uranium exploration, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 106–108, 1967.

There are seven references under the general heading of "regional information", six references to "epigenetic deposition of uranium", and four papers cited as good references to "uranium mineralogy".—HRC

Cohenour, R. E. *See* Doelling, H. H. 07435

07382 **Collins, R. L.** Introduction to Mössbauer spectroscopy, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 18–35, illus., 1967.

Mössbauer spectroscopy furnishes a sensitive tool for examination of the immediate chemical environment of many nuclei. This is not a technique suited to trace element analysis, but sensitivity compares favorably with other tools such as X-ray diffraction. Major effects in the spectra correspond to "s" electron density, the electric field gradient tensor, and the existence of strong magnetic fields. Advances in theory and apparatus are being made, and this opens additional areas to investigation by means of the Mössbauer effect.—Author's abstract

07353 **Colton, George W.** Surface structure map of parts of Lycoming, Clinton, Tioga, and Potter Counties, Pennsylvania: Pennsylvania Geol. Survey Map 14, scale 1:48,000, text, 1967.

Surface bedrock in the map area ranges in age from Late Ordovician to Early Pennsylvanian and comprises about 12,900 feet of rock. In the northwestern section most rocks of the Mississippian System and all younger rocks have been removed by erosion. In the southern part, rocks are intensely deformed.—MCM

02208 **Colville, Alan A.; Ribbe, Paul H.** The crystal structure of an adularia and a refinement of the structure of orthoclase: Am. Mineralogist, v. 53, nos. 1–2, p. 25–37, illus., tables, 1968.

The crystal structures of an adularia (Spencer B) and orthoclase (Spencer C) have been refined by least-squares methods. Although both specimens show diffraction evidence of triclinic domains and weak, diffuse reflections $h+k=2n+1$, they are monoclinic on the average and were refined in space group $C2/m$, giving "average" structures. Bond lengths, bond angles, atomic parameters, chemical compositions, and unit-cell data are given. Relations between structural state in the potassic feldspars, optic axial angle, and birefringence are given.—MR

Conkin, Barbara M. *See* Conkin, James E. 02523

02523 **Conkin, James E.; Conkin, Barbara M.; Canis, Wayne F.** Mississippian foraminifera of the United States—Pt. 3, The limestones of the Chouteau Group

in Missouri and Illinois: Micropaleontology, v. 14, no. 2, p. 133–178, illus., tables, 1968.

The foraminiferal fauna of the Compton, Sedalia and Chouteau Limestones of the Kinderhookian Chouteau Group in Missouri and Illinois described from 83 samples taken at 27 localities, consists of 42 species (including five new, five emended, and one problematic species) belonging to 16 genera and seven families. The fauna of these limestones is essentially identical with fauna of 35 species from the Rockford Limestone of Indiana. About half of the species occur in other Kinderhookian beds from Ohio and Kentucky westward to Oklahoma and Montana. Fourteen Kinderhookian species range downward into the Upper Devonian, and 28, including 11 of the 14, range upward into the Osagean. Seventeen species are restricted to the Kinderhookian, eight occurring widely enough to be regarded as valuable Kinderhookian markers.—*from* Authors' abstract

Cooke, Ronald U. *See* Thrower, Norman J. W. 02508

02477 **Cooper, Byron N.** Profile of the folded Appalachians of western Virginia, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt–Geology Dept. Colloquium Ser. 1), p. 27–64, illus., 1968.

The Virginia area is used to demonstrate that there are two types of Paleozoic stratigraphic variations; one is broadly regional and another is local and commonly structurally controlled. Evidence is given to suggest that the Holston thrust fault is Ordovician in age and that certain Ordovician sediments were derived from it. Other thrust fault planes, once flat, are now folded, and involve both overridden and overriding beds, suggesting that vertical forces were in action even after the horizontal, thrusting forces. The dominant general structure seems to be a geosynclinorium, with individual synclines of deposition forming at different times. Since the basement is involved in the folding, the structures cannot be a regional decollement as suggested by some.—*from* Author's abstract

07497 **Couto, Carlos de Paula.** Pleistocene edentates of the West Indies: Am. Mus. Novitates, no. 2304, 55 p., illus., tables, 1967.

A systematic revision of the genera and species of Pleistocene edentates for the West Indies is presented.—KAF

02218 **Craig, James R.; Kullerud, Gunnar.** Phase relations and mineral assemblages in the copper–lead–sulfur system: Am. Mineralogist, v. 53, nos. 1–2, p. 145–161, illus., tables, 1968.

The phase relations of the Cu–Pb–S system were investigated in evacuated silica tubes at temperatures between 200 and 1130°C. A sulfide liquid, which may be important in ore genesis, remains stable to 508°. Above 523°, this liquid prevents the coexistence of galena and copper sulfides. The addition of iron and zinc to the system does not stabilize the liquid below the minimum melting temperature in the Cu–Pb–S system. H_2O does not measurably effect the melting relations. Phases investigated include galena, chalcocite, digenite, covellite, djurleite, lead, copper, and a new ternary phase.—JSH

Cridland, A. A. *See* Ganders, F. R. 02307

02320 **Cross, A. T.** The source of palynomorphs in the Gulf of California [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 725, 1968.

02482 **Crowell, John C.** The California Coast Ranges, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt–Geology Dept. Colloquium Ser. 1), p. 133–156, illus., table, 1968.

Western California is part of the Cordilleran mobile belt. Great thicknesses (70,000 feet) of eugeosynclinal sediments were deposited and metamorphosed by the Jurassic. Following elevation and thrusting, sedimentation resumed in the Late Jurassic and Early Cretaceous. Cretaceous faulting then occurred, and was followed by more sedimentation in the Late Cretaceous and Early Tertiary. This was followed by

fragmentation by folding and faulting, forming numerous basins and ranges. Major strike-slip faults developed and moved intermittently through time, so that some, like the San Andreas, have lateral displacements up to 200 miles. Deformation is continuing even today in the region and is a combination of compression and strike-slip faulting. Oceanic tectonics nearby are different.—*from* Author's summary

Cumming, L. M. *See* Howie, R. D. 07408

02449 **Currie, K. L.** On the solubility of albite in supercritical water in the range of 400° to 600°C and 750 to 3500 bars: Am. Jour. Sci., v. 266, no. 5, p. 321-341, illus., tables, 1968.

The results of 64 determinations of the solubility of albite by a dynamic method are reported. The departures from equilibrium were experimentally evaluated. The solute, up to 0.3 percent by weight, is not isochemical with albite at any pressure or temperature in the range examined. The size and type of departures from isochemistry depend on pressure, temperature, and the rate of collection of the solutions. The solubility of albite in supercritical water can be quantitatively described by equations derived for non-ideal reaction mixtures. Qualitative calculations indicate that solutions may play an important petrologic role in the regions surrounding dehydrating rock masses.—Author's abstract

Dachille, Frank. *See* Gigl, Paul. 07323

02393 **Daily, Arthur F.** Placer mining, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 928-954, illus., 1968.

Placers are defined as unconsolidated deposits of detrital material containing valuable minerals, and a fundamental classification according to genetic types is given. Minerals recovered from placers include gold, diamond, cassiterite, platinum, gems, and heavy minerals. A suggested sequence of activities in pre-operating studies includes: preliminary field examination and prospecting by sampling and drilling, development prospecting including planned sampling, and basic evaluation. Prospecting methods for fluvial deposits of metallic minerals, beach sands, and diamondiferous deposits are discussed; nine major operations where removal of barren overburden is conducted, and general mining methods are described. In Alaska and Yukon placers have to be thawed before they can be mined. The economics of placer mining and its future are examined in conclusion.—ESL

Dale, William J. *See* Denny, Charles S. 02291

02451 **Dalziel, I. W. D.; Bailey, S. W.** Deformed garnets in a mylonitic rock from the Grenville Front and their tectonic significance: Am. Jour. Sci., v. 266, no. 7, p. 542-562, illus., 1968.

Garnet porphyroclasts in quartzo-feldspathic mylonitic rock from near Sudbury are described. They form oblate spheroids with an axis of symmetry normal to the mylonite foliation. Deformation of the porphyroclasts appears to have been tectonically controlled. There is no crystallographic preferred orientation, but where bend axes in the structure can be detected on Lane photographs, they consistently lie in the mylonitic foliation nearly normal to a prominent regional lineation (elongation of quartz and porphyroclastic feldspar grains). Consideration is given to the significance of the study in the interpretation of minor structures along the Grenville Front and other similar tectonic situations.—*from* Authors' abstract

d'Amico, J. *See* McCorkell, R. 07331

02552 **Darrah, Elsie Louise.** A remarkable branching *Sphenophyllum* from the Carboniferous of Illinois: Palaeontographica, ser. B, v. 121, nos. 4-6, p. 87-101, illus., table, 1968.

A well preserved specimen of *Sphenophyllum* showing four ranks of branching, three types of attached leaves, and a small strobilus is described as fully as preservation permits. The axis combines structures referable to the group of *Sphenophyllum plurifoliatum* Will, *Sphenophyllum fasciculatum* Lx. and *Sphenophyllum lescurianum*

D. W. The strobilus of the *Bowmanites* type has six sporangia in a verticil with relatively large spores of the *Calamospora* form. The specimen, from the Pennsylvanian Kewanee Group from the Sahara Coal mine of Illinois, has been named *Sphenophyllum multirame* sp. nov.—Author's abstract

02321 **Darrah, W. C.** The pteridosperm genus *Lescuropteris*—Characteristics, distribution, and significance [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 725, 1968.

07433 **Dasch, May D.** Uranium deposits of northeastern and western Utah, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 109–128, illus., tables, 1967.

Uranium ore occurs as vein deposits and as peneconcordant deposits from three provinces within the State. Many of the data are summarized in tables. In the Colorado Plateau Province, both types of deposits occur, and several are discussed, including those in the Marysvale area, the Uinta Basin, and the Hurricane Cliffs area. In the Basin and Range Province, several areas are discussed, particularly the Thomas and Tushar Mountains. Only a few tons of ore have come from vein deposits in the Rocky Mountains Province.—HRC

Davies, J. L. *See* Potter, R. R. 02410

02447 **Davis, B. L.; Rapp, G., Jr.; Walawender, M. J.** Fabric and structural characteristics of the martitization process. Am. Jour. Sci., v. 266, no. 6, p. 482–496, illus., tables, 1968.

The replacement of magnetite by hematite is not by octant sectors but is independent of sample coordinates and is penetrative to at least the scale of developed [111] parting. Anisotropy increases with depth into the octahedron. Hematite c-axis orientation perfection occurs 5 mm deep into the crystal. The replacement process consists of initial iron atom diffusion through an oxygen framework leading to maghemite, followed by inversion of maghemite to hematite and the development of a distorted octahedron. Deposition of oxidized iron from the diffusion process combined with contraction caused the reduction in the angle (111)—($\bar{1}\bar{1}1$) from 70.5° to 67° and the concave and convex (111) faces in the distorted martite octahedra.—*from* Authors' abstract

07322 **Davis, Raymond, Jr.; Stoenner, R. W.** Ar-37 and Ar-39 radioactivities in the St. Severin meteorite [abs.]: Meteoritics, v. 3, no. 3, p. 107–108, 1967.

Davison, W. L. *See* Blackadar, R. G. 02441

Davison, W. L. *See* Blackadar, R. G. 02460

Davison, W. L. *See* Blackadar, R. G. 02461

Davison, W. L. *See* Blackadar, R. G. 02462

Davison, W. L. *See* Blackadar, R. G. 02463

02586 **Davison, W. L.** Geology, Nejanilini Lake, Manitoba: Canada Geol. Survey Prelim. Ser. Map 14–1967, scale 1:253,440, text, 1968.

The basement complex of the Nejanilini Lake area in the Churchill structural province consists of highly metamorphosed and deformed rocks and is probably Archean; units are part of the Great Island Group. Minor structures in granulite are complex; large structures are obscured by drift, but northwest and northeast trends seem to be most prominent. In younger rocks, easterly to northeasterly folds prevail. Shear zones are present locally but cannot be traced across drift-covered areas. Great Island sediments and nearby rocks have received much attention from prospectors, but no deposits of economic importance have been reported.—MCM

02567 **DeBuchananne, George D.** Ground-water resources of the Eastern Shore of Virginia and the James, York, and Rappahannock River basins of Virginia east

of the fall line: U.S. Geol. Survey Hydrol. Inv. Atlas HA-284, 2 sheets, scale 1:500,000, text, 1968.

Aquifers in the Coastal Plain of Virginia (tabulated with their water-bearing characteristics) are in unconsolidated sediments of Cretaceous and younger age. Cretaceous aquifers thicken from a few feet in outcrop area to several hundreds of feet in the subsurface and should yield about 55 mgd; Eocene yield is estimated at about 145 mgd, and Miocene about 2,700 mgd, but the lattr has a higher iron content. Quaternary aquifers could yield about 1,100 mgd of water with above-normal iron content and subject to salt-water contamination. Suitability of untreated ground water for public supply is tabulated. Maps show geology, and ground-water availability, quality, and use.—MCM

02602 **Deem, Richard L.; Farouq Ali, S. M.** Adsorption and flow of multiple tracers in porous media: Jour. Canadian Petroleum Technology, v. 7, no. 2, p. 60-66, illus., tables, 1968.

It is common practice to employ radioactive tracers for studying fluid movement in oil reservoirs. In many instances, excessive tracer adsorption and anomalous tracer flow behaviour have been reported. The present investigation was concerned with the phenomena associated with the flow of fluids containing radioactive tracers. Miscible displacements were conducted [in Berea sandstone cores] in order to evaluate tracer retention and/or adsorption effects. A suitable counting and efficiency determination technique was developed in order to evaluate the radioactivities of fluid systems containing two radioisotopes. The use of two radioactive tracers to trace the simultaneous flow of two fluids was found to be a very effective tool.—JCPT

DeFord, Ronald K. *See* Wilson, John Andrew. 02443

Degens, E. T. *See* Deuser, W. G. 02341

02357 **Deines, P.** The carbon and oxygen isotopic composition of carbonates from a mica peridotite dike near Dixonville, Pennsylvania: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 613-625, illus., table, 1968.

The mica peridotite dike at Dixonville, Pennsylvania, belongs to a belt of ultramafic intrusions in eastern North America. Samples in a cross section through the dike, approximately 14 cm wide at the point of study, have been investigated. The carbon and oxygen isotopic composition of carbonate inclusions, of a 1 to 2 mm thick dolomite vein, and of the carbonate contained in the fine-grained matrix of the peridotite were measured. The carbonate inclusions contain the heaviest terrestrial carbon discovered so far, their δC^{13} values with respect to the PDB standard range from 12 to 24.8 per mille. The carbon and oxygen isotopic composition varies systematically through the cross section of the dike, and extremely steep δC^{13} gradients exist.—Author's abstract

02215 **deKimpe, C. R.; Fripiat, J. J.** Kaolinite crystallization from H-exchanged zeolites: Am. Mineralogist, v. 53, nos. 1-2, p. 216-230, illus., table, 1968.

Kaolinite has been synthesized starting from various zeolites, erionite, mordenites and analcite, respectively. In a first stage, hydrogen-exchange was carried out as far as possible. Subsequent hydrothermal treatment under acid conditions during 10 days at 175° or 230°C gave rise to kaolinite formation. Transformation scale corresponds to erionite>natural and a synthetic mordenite>analcite and zeolon, a commercial synthetic mordenite. The mode of formation is discussed in relation with the internal accessibility of the zeolites.—Authors' abstract

02304 **Delevoryas, T.** Middle Jurassic glossopterid foliage from Oaxaca, Mexico [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 726, 1968.

02322 **Delevoryas, T.; Taylor, T. N.** A probable pteridosperm with eremopterid foliage from the Allegheny Group of northern Pennsylvania [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 725-726, 1968.

02548 **Delevoryas, T.** Investigations of North American cycadeoids—Structure, ontogeny, and phylogenetic considerations of cones of *Cycadeoidea:* Palaeontographica, ser. B, v. 121, nos. 4–6, p. 122–133, illus., 1968.

Detailed studies of many cones from geographically and stratigraphically unidentified locations show that cone buds need not lead to fertile cones and that various stages of cone development have been petrified so that ontogenetic development can be detected. Some cycads produced only ovulate cones; pollination of these from other sources is discussed. The "annular shoulders" of some cones may be the remains of disintegrated microsporophylls. Cones of *Cycadeoidea* in the Jurassic and Cretaceous were derived from Triassic williamsonians while cycad microsporangiate structures resemble certain pteridosperm structures of Paleozoic age; the origin of the ovulate structures is uncertain.—HRC

DeMatteo, J. *See* Bradley, C. L. 07450

Denahan, Stephen A. *See* Blanchard, Frank N. 07394

02347 **Dennis, R. L.** Fossil fungal mycelium with clamp connections from the Middle Pennsylvanian [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

02291 **Denny, Charles S.; Warren, Charles R.; Dow, Donald H.; Dale, William J.** A descriptive catalog of selected aerial photographs of geologic features in the United States: U.S. Geol. Survey Prof. Paper 590, 79 p., illus., 1968.

This catalog lists and describes 317 sets of aerial photographs (9- by 9-inch contact prints) available for purchase from the U.S. Geological Survey. The sets are arranged on a geographic basis, and location of each set is shown on a map. Most sets are of vertical photographs and provide stereoscopic coverage. The features shown are listed in an index. Information given for each set includes location, scale and date of photography, a brief description of the features illustrated, and reference to a geologic report and topographic map of the area.—CSD

02201 **Dent Glasser, L. S.; Glasser, F. P.** The crystal structure of walstromite: Am. Mineralogist, v. 53, nos. 1–2, p. 9–13, illus., tables, 1968.

The crystal structure of walstromite, $Ca_2BaSi_3O_9$, has been determined by X-ray structure analysis using two-dimensional data. It contains $(Si_3O_9)^{6-}$ rings; the coordination of the divalent cations is highly irregular.—Authors' abstract

02341 **Deuser, W. G.; Degens, E. T.; Guillard, R. R. L.** Carbon isotope relationships between plankton and sea water: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 657–660, illus., 1968.

Marine plankton show a variation in C-13 from -9 to about -30 per mille. The fractionation with respect to the oceanic inorganic carbon appears to be due only to the photosynthetic process in the phytoplankton. The wide range can be explained on the basis of new laboratory experiments as being due to environmental differences in temperature, pH, and carbon availability.—Authors' abstract

07489 **deWaard, Dirk.** Absolute P–T conditions of the granulite-facies metamorphism in the Adirondacks: Koninkl. Nederlandse Akad. Wetensch. Proc., ser. B, v. 70, no. 4, p. 400–410, illus., 1967.

Minimum temperatures for metamorphism in the Adirondacks, N.Y., were estimated at 525°–625° (Engel and Engel, 1958, 1962) and 550°–650° (Buddington and Lindsley, 1964). Present estimates suggest temperatures at least 150° higher. Minimum P_{water}–T conditions are based upon the intersection of experimental hydration and melting curves, and P_{load}–T conditions upon intersection of extrapolated curves for the solvus crest of alkali feldspars and for the reaction: orthopyroxene+anorthite⇌clinopyroxene+garnet+quartz. At least 700° at the hypersthene isograd and 760° at the garnet clinopyroxene isograd are suggested. Most of the Adirondack Highlands had temperatures of at least 800°C and load pressure as high as 10 kb or depth of 35 km. Water-vapor pressure must have

been considerably lower, unless metamorphic temperatures were at least 100° higher than the estimated minima.—GDC

07530 **deWaard, Dirk.** On the origin of anorthosite by anatexis: Koninkl. Nederlandse Akad. Wetensch. Proc., ser. B, v. 70, no. 4, p. 411–419, illus., 1967.

Massif-type anorthosite, commonly explained by fractional crystallization from primary magma, could equally well be a residuum of partial melting of a plagioclase-rich parent. The anatectic interpretation, by in situ formation of anorthosite and melt, avoids the difficulty of forcefully introducing large masses of primary magma. Published experimental data indicate the possibility of such anatectic residuum from available crustal materials at temperatures and pressures of the katazone. Dependent on parent composition, the melting curve of its fused fraction, intersecting with the upper stability curve of the amphibole potentially present in the plagioclase residuum, gives a minimum temperature of about 875°C at less than 1 kb partial pressure of water vapor for the formation of Adirondack-type anorthosite.—GDC

Dewes, F. C. D. *See* Buchan, S. 07392

07404 **Dietrich, R. V.** A geobarometer for certain migmatites: Finlande Comm. Géol. Bull. 229 (Soc. Géol. Finlande Compte Rendus, no. 39), p. 5–9, illus., 1967.

Laboratory data indicate that at pressures greater than approximately 1.7 kb, Na-rich plagioclase plus quartz starts to melt at lower temperatures than K-feldspar plus quartz, whereas at pressures of less than approximately 1.7 kb, the reverse relationship obtains. A specimen of banded migmatite from southern Finland, cut by a veinlet, is described. The distribution of minerals in the veinlet shows that the plagioclase-quartz composition fluid became mobile before K-feldspar-quartz; this is attributed to anatexis above approximately 1.8 kb. An addendum describes a similar rock from the Adirondacks.—ESL

02308 **Dilcher, D. L.** *Sequoia*, an element of the Eocene flora in southeastern North America [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 727, 1968.

02319 **Dilcher, D. L.** Revision of Eocene palms from southeastern North America based upon cuticular analysis [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 725, 1968.

07527 **Dill, Robert F.** Effects of explosive loading on the strength of sea-floor sands, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 291–303, illus., tables, 1967.

Diver-obtained vane-shear strength measurements show that marginally stable sand-sized sediments are significantly stronger in areas of recent blasting than in areas of normal sea floor sedimentation. Shear strength values ranging between 2.0 and 2.4 psi were measured for sediments six inches beneath the sea-floor surface in areas where blasting had been used to clear a channel through the reef of Discovery Bay, Jamaica; whereas values of less than 1.0 psi were representative for similar sediments, occurring at the same depth in areas not subject to explosive loading.—*from* Author's abstract

07370 **Dillon, Howard B.; Andersland, O. B.** Deformation rates of polycrystalline ice, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 313–327, illus., tables, 1967.

Results of a series of creep tests at constant stress, and a few constant strain rate tests, performed on cylindrical polycrystalline ice samples at several temperatures are presented. Data available in the literature have been incorporated to give expressions, based on the rate process theory, describing the overall dependence of strain rate on stress and temperature. Boundaries of ice grains or slip along basal planes of single ice crystals are probably involved. It may be possible to correlate the deformational behavior of polycrystalline ice with that of frozen soils.—ESL

02553 **Dionne, Jean-Claude.** Schorre morphology on the south shore of the St. Lawrence Estuary: Am. Jour. Sci., v. 266, no. 5, p. 380–388, illus., 1968.

The salt marshes are characteristic of a cold-temperature region. Ice is an important morpho-sedimentological agent. A large quantity of boulders and coarse sediments are brought by drift ice which also digs and ploughs the surface of the schorre during winter and spring. Four types of salt marshes are common: The first is characterized by numerous shallow subcircular or irregular shaped pans, the second by an abundance of erratics, mostly crystalline boulders, the third by a rocky platform overlaid by a thin veneer of mud, and the fourth is a muddy schorre similar to common marshes of the Atlantic coast of southeastern Canada. The first three have never been described as such in coastal literature. *Schorre* is a Dutch word that refers to that part of a salt marsh covered by high tides.—*from* Author's abstract

02280 **Distelhorst, Carl A. R.; Milnes, A. G.** Evidence for fault zones in the bedrock of Milwaukee County: Wisconsin Acad. Sci., Arts and Letters Trans., 1967–68, v. 56, p. 149–152 [1968].

In constructing bedrock structure contours from boreholes that penetrate the Niagaran Dolomite and underlying Maquoketa Shale, the Silurian–Ordovician contact provides a convenient horizon. A discontinuity which runs southwestward from the mouth of the Milwaukee River represents a fault zone, previously thought to be a fold structure, in which strata on the south side have been displaced eastward. Using the Devonian–Silurian boundary, a more tenuous evidence of displacemen' was found in the northeast corner of the county along a narrow zone running eastnortheast–westsouthwest, where anomalies are also obtained for the Silurian–Ordovician boundaries. This northern zone is probably a continuation of a northeast striking fault known to exist under the town of Waukesha to the west. The downthrown block lies between the two Milwaukee zones.—GDC

07435 **Doelling, H. H.; Cohenour, R. E.** Field trip road log, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 150–194, illus., 1967.

The first day of the trip runs from Moab to Blanding, 177 miles. There are 8 stops along the way, mostly at uranium mines. The second day of the trip is from Blanding to the Henry Mountains area to the west, 237 miles. Seven stops are made, all at uranium mines and geomorphic sites. Some of the stops are described in detail.—HRC

Doerner, D. P. *See* Kleinpell, R. M. 07463

07351 **Dolgoff, Anatole.** Graduate record examination—Geology, advanced test: New York, Arco Publishing Co., 105 p., illus., 1967.

02268 **Dolman, J. D.; Buol, S. W.** Organic soils on the lower coastal plain of North Carolina: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 414–418, illus., tables, 1968.

The organic deposits on the lower coastal plain of North Carolina form a blanket of variable thickness over a mineral landscape, dissected during the Wisconsin glacial period. Soils developed in the organic deposits show a distinct relation to their position over the pre-peat landscape. The soils over the higher parts of the pre-peat landscape consist of debris from a mixed swamp forest vegetation, have brown to black colors, are well aerated, friable, and show considerable faunal activity. The soils over the lower parts of the pre-peat landscape are formed from *Nyssa-Taxodium* swamp vegetation, are reddish-brown to dark-reddish brown in color, poorly aerated, colloidal, and paste-like when wet. They are more acid than the shallow organic soils, and show little evidence of faunal activity. Translocation of organic matter can be observed in the shallow organic soil but not in the deep soil. The organic matter in the deep soil is more resistant to oxidation than that in the shallow soil.—*from* Authors' abstract

02559 **Donnay, Gabrielle; Allmann, R.** Si_3O_{10} groups in the crystal structure of ardennite: Acta Cryst., v. B24, pt. 6, p. 845–855, illus., tables, 1968.

A total of 900 reflections were obtained on a Weissenberg-type diffractometer supplemented by Weissenberg and precession film data. The structure was refined by least-squares method. The crystal structure can be derived from that of epidote by ITO-type twinning; it leads to the Si_3O_{10} groups which strengthen the bond chains along c. As in epidote, chains of octahedra sharing edges extend along b. They are here connected by the SiO_4 and Si_3O_{10} groups. The cleavage is given as (001) in the literature for both minerals; but was determined to be (100) by the authors. $(As,V)O_4$ tetrahedra do not share corners with SiO_4 tetrahedra. The polyhedra around Mn and especially (Mn,Ca) are irregular, suggesting abnormal magnetic behavior for ardennite. Bond lengths and temperature factors are normal. The angle Si–O–Si is 126°.—*from* Authors' abstract

02226 **Donnelly, Thomas W.** Kinetic considerations in the genesis of growth twinning—A reply [to discussion of 1967 paper by H. Carstens, 1968]: Am. Mineralogist, v. 53, nos. 1–2, p. 344–346, 1968.

In reply to Carstens (ibid., p. 344–346) the author indicates that many factors may be important in the growth and twinning of crystals.—JSH

Dorman, J. *See* Herron, E. M. 02336

02539 **Dort, Wakefield, Jr.** Paleoclimatic implications of soil structures at the Wasden site (Owl Cave): Tebiwa, v. 11, no. 1, p. 31–36, 1968.

Lake sediments about 5 m thick, exposed by archaeologists in the lava plains of eastern Idaho, are divided into thirds by a layer of volcanic ash in the upper part and a bone bed in the lower. Pointed vertical structures 50 to 200 mm wide, particularly in involuted bedding below the bones, have features characteristic of ice-wedge casts. Unlike limestone caverns, Owl Cave is a small roof opening in a lava tube, perhaps a cold-air sump. No fragments from the bone bed are in the wedge casts, indicating a time interval of stability and intense cold before bones accumulated. A C-14 date of 8160±260 yr BP, obtained from charcoal 12 cm below the bones, suggests the last stade of the Pinedale Glaciation. Smaller wedges in sediment above the bones are covered by ash presumed to be from Mt. Mazama.—GDC

02590 **Dover, T. B.; Leonard, A. R.; Laine, L. L.** Water for Oklahoma: U.S. Geol. Survey Water-Supply Paper 1890, 107 p., illus., 1968.

This semipopular account delineates the use of water in Oklahoma, its distribution and management, and features affecting its supply. Resources of High Plains, western Oklahoma, central and eastern plains, Ozark Plateaus, and southeastern section are discussed and illustrated. Water supplies for principal urban areas are treated separately. Progress in control of oil field pollution is improving quality of water in many small streams, but rapid urban growth strains capacity of many municipal sewage plants, thus increasing the threat of stream pollution. Although reservoirs have improved some flow conditions and water quality, recently built small stockponds result in increased water loss by evaporation. Phreatophytes are spreading into thousands of acres along western streams, ground-water reservoirs in some areas are little used, and some counties face problems of overdevelopment. A program of both development and conservation is needed.—MCM

Dow, Donald H. *See* Denny, Charles S. 02291

Drake, C. L. *See* Herron, E. M. 02336

Dreeszen, V. H. *See* Keech, C. F. 02597

02405 **Dreimanis, A.** St. Thomas sheet, southern Ontario (bedrock topography series): Ontario Dept. Mines Prelim. Map P. 482, scale 1:50,000, 1968.

02406 **Dreimanis, A.** Port Stanley sheet, southern Ontario (bedrock topography series): Ontario Dept. Mines Prelim. Map P. 483, scale 1:50,000, 1968.

07363 **Duane, David B.** Characteristics of the sediment load in the St. Clair River, *in* Conf. on Great Lakes Research, 10th, Toronto, Ontario, 1967, Proc.: Ann Arbor, Mich., Internat. Assoc. Great Lakes Research, p. 115–132, illus., tables, 1967.

Analysis of data collected at a section downstream from Blue Water Bridge, indicates that suspended load and bedload vary with time and location in the river cross section; in general sediment load is directly related to waves impinging upon lower Lake Huron beaches, and load distribution is not symmetrical. Material comprising the suspended load is a combination of particulate terrigenous matter and organic material similar to filamentous fibrous alga. In overall aspect sand grains comprising sediment load are identical to sand comprising beaches and nearshore bottom of lower Lake Huron. The river profile at the metered section shows remarkable uniformity as depicted by soundings. This aspect of the channel, reinforced by characteristics of sediment load and in situ observations of portions of the river bottom, indicates that the river, in the upper reaches, has a stable channel.—*from* Author's abstract

Dubberke, W. *See* Welp, T. L. 02557

07472 **Dunne, James A.; Nickle, Neil L.** Balanced filters for the analysis of Al, Si, K, Ca, Fe, and Ni, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 336–355, illus., table, 1967.

The balanced filter technique offers a satisfactory method of dispersion in the Z region studied. The primary X-ray flux available at the sample surface is more than adequate to allow X-ray fluorescence analysis of the elements when they exist in amounts greater than one percent by weight. The Cu target X-ray tube is, however, far from optimum for the analysis of Al and Si. The relatively poor performance on Si and Al, combined with escape peak interference with Ca and K analyses, suggest the use of Ni rather than Ar counting gas in this particular application.—*from* Authors' abstract

07471 **Durham, David L.** Annotated list of selected papers on Gabilan Range geology, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 106–110, 1967.

The 86 entries in this bibliography include most of the published reports and geologic maps on the Gabilan Range and adjacent areas along the San Andreas fault from Bitterwater Valley to San Juan Bautista and Hollister. Only a few economic references are given. A list of seven theses, containing unpublished data, follows the compilation of published material.—ESL

02286 **Eakins, Gilbert R.** Geochemical report of the Wood River Lakes-Tikchik Lakes region [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 57 [1968].

02479 **Eardley, A. J.** Major structures of the Rocky Mountains of Colorado and Utah, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt-Geology Dept. Colloquium Ser. 1), p. 79–99, illus., 1968.

Evidence is presented to show that the Ancestral Rockies and the Laramide Rockies are the result of vertical movement of the silicic crust. The uplifts are caused by the rise, from the upper mantle, of basalt in scattered places to the base of the silicic crust. This rise domed the silicic crust and the overlying sedimentary rock veneer. The surficial structures are viewed as gravity-caused mass movements along the flanks of the uplifts and as synclinoria of Paleozoic strata between uplifts. This theory also relates widespread magmatism to tectonism in a reasonable manner. It could also explain the regional Cenozoic uplift in the Rockies. Also, the Basin and Range faulting is the result of the rise of sufficient magma from the mantle to form a continuous layer under the silicic crust of the miogeosyncline, creating new forces.—*from* Author's abstract

Easton, A. J. *See* Moss, A. A. 07455

02303 **Eggert, D. A.; Kryder, R. W.** A new species of the pteridosperm pollen organ genus *Aulacotheca* [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 726, 1968.

Eggert, D. A. *See* Frankenberg, J. M. 02314

Eggert, D. A. *See* Taylor, T. N. 02323

Eggert, D. A. *See* Taylor, T. N. 02349

02272 **ElGoresy, Ahmed.** Electron microprobe analysis and ore microscopic study of magnetic spherules and grains collected from the Greenland ice: Contr. Mineralogy and Petrology, v. 17, no. 4, p. 331–346, illus., table, 1968.

Seven groups of magnetic spherules and grains have been identified in Greenland ice from microscope and microprobe studies. Magnetite is the most abundant mineral in the seven groups, and many spherules are entirely of magnetite making it difficult to distinguish cosmic spherules from artifacts. No skeletal intergrowth was observed in the magnetites and it is unlikely that they are ablation products of any type of meteorite. One composite spherule is probably of cosmic origin, however, because of the presence of both Ni and Co in the metal phase in amounts close to that of kamacite in meteorites; another composite grain of titanomagnetite, ilmenite, hematite, and pyroxene is probably from the metamorphic complex of Greenland. The mineralogy and chemistry of the observed magnetite spherules and grains are discussed in detail.—VSN

Elliott, C. J. *See* Moss, A. A. 07455

07414 **Emery, K. O.** The Atlantic continental margin of the United States during the past 70 million years [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 53–70, illus., 1967.

The margin form was established during Mesozoic diastrophism, the slope and Blake Plateau probably by early faulting or steep folding; later trenches parallel to the coast, a strike dip fault near New York, and Cape Fear Arch developed. Trenches received great thickness of Cretaceous sediments. Tertiary sediments were over 800 m thick on the outer shelf and slope between New York and Cape Hatteras, twice that across southern Florida and the Bahama Banks, prograding the shelf an average of 7 km north of Cape Hatteras. Pleistocene sediments average 80 m on the open shelf; postglacial deposits are thickest in Gulf of Maine and Long Island Sound, and absent on outer shelf but present on slope and rise. Rates of Quaternary deposition were higher than those since early Cretaceous or early Tertiary.—GDC

02594 **Emmett, W. W.; Hadley, R. F.** The Vigil Network—Pt. C, Preservation and access of data: U.S. Geol. Survey Circ. 460–C, 21 p., illus., tables, 1968.

Recognition of deficiency in detailed data on hydrologic and geomorphic processes led to establishment of a network of small drainage basins and other sites where observations of basic processes would be made over long periods of time. The plan for filing data from sites in a uniform manner in designated international repositories and requirements of contents of the repository file are outlined. Types of observations and examples of tabulation are stream-channel and valley-floor, hillslope erosion, reservoir sedimentation, precipitation, and vegetation measurements. The two permanent repositories—U.S. Geological Survey, Washington, D.C., and University of Uppsala, Uppsala, Sweden—will enable scientists to find field locations where observations of geomorphic processes are being made. Procedures and data arrangements are suggested and a sample is appended.—MCM

02564 **Enciso de la Vega, Salvador.** Carta geológica de México—Hoja Cuencame 13 R–1(7): México, D.F., México Univ. Nac. Autónoma Inst. Geología, scale 1:100,000, sections, text, 1968.

The Cuencame area in Durango is located within the northeastern border of the Meseta Central. Strata ranging from the Jurassic La Casita Formation to

Quaternary alluvium are described in detail. All Mesozoic marine rocks have been intensely folded and numerous normal faults are present. In the Sierra de Yerbanis the emplacement of the El Orito stock raised the adjacent marine rocks as well as the folds. Minerals of economic importance are clays, kaolin, phosphate, building stone, antimony, mercury, gold, and manganese.—MCM

02230 **Estep, Patricia A.; Karr, Clarence, Jr.** The infrared spectra of dawsonite: Am. Mineralogist, v. 53, nos. 1–2, p. 305–309, illus., tables, 1968.

The infrared spectra of three natural and one synthetic dawsonite are presented and assignment of bands is made. The spectra permit identification and quantitative estimation of dawsonite content in natural samples.—JLH

02276 **Evans, Bernard W.; Moore, James G.** Mineralogy as a function of depth in the prehistoric Makaopuhi tholeiitic lava lake, Hawaii: Contr. Mineralogy and Petrology, v. 17, no. 2, p. 85–115, illus., tables, 1968.

The electron probe X-ray microanalyzer has been used to determine compositional variability of groundmass minerals and glass in 10 specimens from a 225-ft section of the lava lake. The order of beginning of crystallization was: chromite, olivine, augite, plagioclase, pigeonite, iron-titanium oxides and orthopyroxene, alkali feldspar and apatite, and glass. The basalt is hypersthene normative throughout and tholeiitic, but the top chill zone has an alkali basalt flavor that could have given a false picture. Since they are dependent on cooling history, some of the modal criteria commonly used for recognizing basalt types, such as the absence of Ca-poor pyroxene, presence of groundmass olivine, and the presence of alkali feldspar, should be applied with caution. Petrographic comparison of basalts from one flow, volcano, or province, with another, should recognize the possible variations due to cooling history alone.—ESL

Evans, J. G. *See* Ketner, K. B. 02595

02465 **Evans, John W.** The effect of rock hardness and other factors on the shape of the burrow of the rock-boring clam, *Penitella penita*: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 4, no. 4, p. 271–278, illus., 1968.

Penitella penita, a west coast rock-boring clam, forms a conical burrow in the rock the shape of which is controlled by a number of environmental variables, the most important of these being substrate hardness. A method for determining the relative friability hardness of sandstone is described. The possibility that this information could be used by the paleontologist to establish the hardness of sedimentary rock at known times in the past is discussed.—Author's summary

02445 **Everitt, Ben L.** Use of the cottonwood in an investivation of the recent history of a flood plain: Am. Jour. Sci., v. 266, no. 6, p. 417–439, illus., 1968.

A ring count of cottonwood trees along the Little Missouri River in western North Dakota has permitted contouring of the age of floodplain forests. The germination and growth of the cottonwood is closely related to the discharge of the river, movement of the channel, and development of the floodplain. The trees, in bands, show an orderly increase in age upvalley and away from the channel. Each band is the result of the rise of a thicket on a riverside sandbar and, thus, a record of recent migrations of the channel. A model of channel migration and sediment transport has been constructed. Evidence indicates that the channel has been within a few feet of its present elevation for the past 150 years.—*from* Author's abstract

02318 **Eyde, R. H.; Barghoorn, E. S.** Fossil record of Alangiaceae [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 725, 1968.

Farouq Ali, S. M. *See* Deem, Richard L. 02602

Fehrenbacher, J. B. *See* Frazee, C. J. 02237

02348 **Felix, C. J.; Burbridge, P. P.** A study of the stratigraphical and morphological development in the spore genus *Spencerisporites* [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

07348 **Ferguson, S. A.** (and others). Leitch Gold Mines Limited, surface plan of eastern part of property, parts of Eva and Summers townships, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 484, scale 1 in. to 300 feet, text, 1967.

Oldest rocks in the Leitch Gold Mine property are felsic to intermediate metavolcanics, overlain by a group of metasediments, and all intruded by diorite and diabase. General trend of structures are N. 70°–85° E., and dips are 65°–85° N. Small faults in the mine are related to block faulting and generally strike from N. 20° E. to N. 20° W. Veins consist mainly of quartz with some banding parallel to the walls due to films of sericite and chlorite. Pyrite, tetrahedrite, and sphalerite occur in small quantities and gold is present in the veins but not in the wallrock. Productive parts of the veins vary in width from 4–24 inches and where vein width is more than four feet, gold content is below ore grade. From 1936 to 1965, 847,291 oz gold was mined.—MCM

07482 **Ferguson, S.A.** (compiler). Leitch Gold Mines Limited, subsurface No. 1,900-foot level; subsurface No. 2,4525 foot level, parts of Eva and Summers townships, District of Thunder Bay: Ontario Dept. Mines. Prelim. Geol. Map P. 485, scale 1 in. to 500 feet, 1967.

07484 **Fine, Morton S. and Associates.** Dinosaur State Park, Rocky Hill, Connecticut—A master plan report: Bloomfield, Conn., Morton S. Fine and Associates, 40 p., illus., 1967.

Discovery of dinosaur tracks, in this Triassic valley area south of Hartford, stopped bulldozing and further work for a Highway Department building on the site. This report of a study to determine the development potential of a trackway park, includes one chapter on its geological background, another on its scientific and educational values, and three on site analysis, architectural design, and phasing of development.—GDC

02578 **Fischer, A. G.** Earth science and the electron microscope: Am. Scientist, v. 56, no. 2, p. 130–137, illus., 1968.

The applications of electron microscopy are outlined with citation of several examples. The three general types described are: transmission electron microscopy of actual objects (dependent upon the original opacity of the material), transmission electron microscopy of replicas, in which an electron-translucent skin is coated over the surface to be examined, and, the latest development, scanning electron microscopy in which an electron beam scanning an object can be made to yield a TV-type image from secondarily emitted electrons. Examples of pictures from rocks and fossils are illustrated.—HRC

Fischer, D. W. *See* Baun, W. L. 07377

02575 **Fisher, Richard V.** Pyrogenic mineral stability, lower member of the John Day formation, eastern Oregon: California Univ. Pubs. Geol. Sci., v. 75, 39 p., illus., tables, 1968.

Pyrogenic minerals of these Oligocene rocks are andesine, and lesser amounts of oligoclase and labradorite, with magnetite as the dominant accessory mineral, and ilmenite second. Rock colors correlate with mineral alteration, with loss of red color upward and increase in ferromagnesians. Climate was tropical to subtropical, and land well-drained with some lava-dammed lakes when the ash fell. Comparison of Al_2O_3, TiO_2, and total iron with those of Hawaiian laterites indicates that the red tuffs are immature laterites. Stability order of pyrogenic minerals differs according to environment—in red rocks where organic matter is absent, and in drab rocks where organic matter is often present. Stability series are tabulated for two groups, and reaction and bonding energies are shown on graphs. A measured section of the lower member accompanies the report.—ESL

02427 **Fiske, R. S.; Koyanagi, R. Y.** The December 1965 eruption of Kilauea Volcano, Hawaii: U.S. Geol. Survey Prof. Paper 607, 21 p., illus., tables, 1968.

More than 1 million cubic yards of tholeiitic basalt was erupted from the upper east rift zone of Kilauea Volcano on December 24 and 25, 1965. Measurement of ground tilt and altitude change show that Kilauea summit inflated before the eruption, and that it abruptly deflated during, and for a 10-hour period after, the eruption. Extensive faulting and ground cracking in the upper east rift and Koae fault system accompanied the activity, and it is interpreted that a large segment of Kilauea's south flank was displaced seaward by forceful wedging of the magma that intruded the east rift zone.—RSF

Fleming, J. M. *See* Papezik, V. S. 07412

07386 **Fletcher, G. L.** Post late Miocene displacement along the San Andreas fault zone, central California, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Sec., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 74–80, illus., 1967.

The San Andreas fault zone follows a narrow, very straight topographic trough through central California. The area from the San Emigdio Mts. to Hollister is studied here. A single reference area—the Santa Margarita conglomerate section along the west flank of the southern Temblor Range—east of the fault, areally limited and distinctive was selected to correlate with an area west of the fault. A number of criteria for correlation were established and three regions on the west of the fault, the Red Hills, Parkfield, and Pinnacles areas, were chosen as possible correlatives. The first two showed different source areas, but the Pinnacles satisfied every major condition for correlation. If the Pinnacles area was adjacent to the southern Temblor Range, there has been about 160 mi of right lateral movement since the late Miocene.—ESL

02222 **Ford, Arthur B.; Boudette, Eugene L.** On the staining of anorthoclase: Am. Mineralogist, v. 53, nos. 1–2, p. 331–334, illus., 1968.

Antarctic anorthoclase phenocrysts of trachytes from Cape Royds, Ross Island (2.8 weight percent K_2O) and from Crary Mountains, Byrd Land (2.6 weight percent K_2O), take on a pale red purple stain during reaction in a modification of the multifeldspar staining method. This method permits the phenocrysts to stand out in strong contrast to the dense matrix in which the feldspars are stained bright yellow. Anorthoclase containing more potassium and less calcium than these samples might yield different results.—MEM

Foss, J. E. *See* Wright, W. R. 02261

02267 **Foss, J. E.; Rust, R. H.** Soil genesis study of a lithologic discontinuity in glacial drift in western Wisconsin: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 393–398, illus., tables, 1968.

A study was made of soils developed in superposed parent materials in St. Croix and Pierce Counties, Wis. A typical stratigraphic sequence consists of: post-Cary loess, Cary till or mixed zone (14,000 B.P.), Rockian till (30,000 years B.P.), and Paleozoic sedimentary rocks. The Cary drift is thin over much of the uplands; thus, soil profiles are developed in both the Cary and Rockian drifts. Morphological data indicate the presence of a paleosol on the Rockian till. This was substantiated by physical, chemical, and mineralogical analyses. Paleosol characteristics include accumulation of clay in the B horizon, translocated iron, and a strongly leached solum. The $CaO:ZrO_2$ and $Fe_2O_3:ZrO_2$ molar ratios of selected size fractions indicate a weathering interval between deposition of the Cary and Rockian sediments. Clay mineral analyses show variation in lithology and weathering of the drifts.—*from* Authors' abstract

Foster, Helen L. *See* Holmes, G. William. 02428

Foster, W. R. *See* Lin, H. C. 02219

Frank, Evelyn R. *See* Cadle, Richard D. 02333

02314 **Frankenberg, J. M.; Eggert, D. A.** Stigmarian system of *Sigillaria* from the Upper Pennsylvanian of Illinois [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 724, 1968.

02315 **Frankenberg, J. M.** Abscission of lateral appendages of *Stigmaria* [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 724, 1968.

Franklin, Fred A. *See* Wright, Frances W. 07449

02237 **Frazee, C. J.; Odell, R. T.; Fehrenbacher, J. B.** Hydraulic conductivity and moisture regimes in solonetzic and associated soils in south-central Illinois: Soil Sci., v. 105, no. 5, p. 362–368, illus., 1968.

The water tables in solonetzic soils tend to be lower and fluctuate less than the water tables in associated soils, because the sola of solonetzic soils are less permeable. The moisture content, by volume, in solonetzic soils is higher than in associated soils for the 2-ft depth. The sodium content of ground-water samples from solonetzic soils and the underlying till is significantly greater than from associated soils and their underlying till.—JWH

07490 **Fredskild, Bent.** Postglacial plant succession and climatic changes in a West Greenland bog, *in* Quaternary palynology and actuopalynology: Rev. Palaeobotany and Palynology, v. 4, nos. 1–4, p. 113–127, illus., 1967.

Sections and profiles at Sermermiut, western Greenland, illustrate the plant succession during the last 3,000 years. The following succession is deduced: a seashore with *Elymus* and *Stellaria humifusa*; a grass-mat dominated by *Alopecurus alpinus*; a *Betula nana* heath; a *Salix glauca* scrub; a *Sphagnum squarrosum* bog with a number of hydrophilous species; a grass-mat with dwarf shrubs; a *Sphagnum squarrosum* bog; and after a lacuna, the present moss carpet. Radiocarbon datings have shown that the humid conditions responsible for change into the first *Sphagnum* bog were contemporaneous with RY III in northwestern Europe (about 600 B.C.), while the second growth of *Sphagnum* starts about A.D. 400 (RY II).—*from* Author's summary

02185 **Frey, Robert W.** The lebensspuren of some common marine invertebrates near Beaufort, North Carolina—[Pt.] 1, Pelecypod burrows: Jour. Paleontology, v. 42, no. 2, p. 570–574, illus., 1968.

The burrows of the pelecypods *Solemya velum*, *Tagelus plebeius*, and *T. divisus* are described, figured and compared. *Solemya velum* forms a Y-shaped burrow extending downward 7–8 cm. The burrows of both species of *Tagelus* are similar curved structures which V at the top for passage of the siphons to the water-sediment interface; *Tagelus* burrows extend from 15–40 cm into the sediment.—JP

Fripiat, J. J. *See* deKimpe, C. R. 02215

Frye, John C. *See* Schultz, C. Bertrand. 02339

02340 **Frye, John C.; Willman, H. B.; Glass, H. D.** Correlation of midwestern loesses with the glacial succession, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 3–21, illus., 1968.

In the Midwest and central Great Plains region, the extensive thick deposits of loess are intimately related to the advance and retreat of the continental glaciers. The loess reflects a stratigraphy similar to that of the till sheets, and it is intermeshed with the tills. Stratigraphic data from both the till and the loess sequences serve to supplement each other.—MST

02533 **Frye, John C.; Glass, H. D.; Willman, H. B.** Mineral zonation of Woodfordian loesses of Illinois: Illinois Geol. Survey Circ. 427, 44 p., illus., tables, 1968.

Woodfordian loesses of central and western Illinois are zoned by their clay-mineral composition. Zones are related to composition of outwash in the major source valleys. In the Illinois Valley three zones are distinguished by successively high amounts of illite. In the Mississippi Valley low amounts of illite and high amounts of montmorillonite occur in the bottom and top zones with a middle zone of higher amounts of illite. In north-central Illinois a still higher zone, characterized by high amounts of montmorillonite, overlies the other zones. The relative degree of mineral alteration in modern soils is evaluated by the development of a "heterogeneous swelling index". Data suggest that surface soils in west-central Illinois loess formed during 12,000±1,000 radiocarbon yr; those in the central Illinois Valley formed during 14,000±1,000 yr.—*from* Authors' abstract

Fujii, Naoyuki. *See* Fujisawa, Hideyuki. 02331

02331 **Fujisawa, Hideyuki; Fujii, Naoyuki; Mizutani, Hitoshi; Kanamori, Hiroo; Akimoto, Syun-iti.** Thermal diffusivity of Mg_2SiO_4, Fe_2SiO_4, and NaCl at high pressures and temperatures: Jour. Geophys. Research, v. 73, no. 14, p. 4727-4733, illus., tables, 1968.

Pressure and temperature variations of thermal diffusivity of polycrystalline Mg_2SiO_4 have been measured at 24 to 50 kb and 400° to 1300°K. Effect of the olivine-spinel phase transition on thermal diffusivity of Fe_2SiO_4 was studied at 49.5 and 350° to 650°K. The reciprocal of thermal diffusivity 1/kappa of Mg_2SiO_4 increases linearly to 1,200°K, but is nearly constant above that; 1/kappa versus temperature curve of Fe_2SiO_4 is straight to 700°K, then slightly convex. Measured thermal diffusivity of NaCl agrees reasonably well with Bridgman's data; pressure dependence for NaCl is explained by photon conduction. The effect of radiative heat transfer in Mg_2SiO_4 is discussed; the photon mean free path is estimated to be 0.3 mm at 1,400°K.—DBV

07502 **Fulton, R. J.** Deglaciation studies in Kamloops region, an area of moderate relief, British Columbia [with French abs.]: Canada Geol. Survey Bull. 154, 36 p., illus., tables, geol. maps, 1967.

For an area of moderate relief, four phases of deglaciation are proposed: active flow, transitional upland appearance, stagnant-ice confined to valleys, and dead-ice. Relationships between glaciers and deposits in each of four small model areas in this region suggest that: major control is not ice regime but topography, particularly valley shape; drainage regime reflects ice-front position, ice-sheet regime, meltwater supply, and nature of topography; orientation of a stagnant tongue affects slope of ice-surface and direction of melting; ponding of major valley leads to thick lacustrine deposits near entry of meltwater; melting of tongues in deep valleys produce kettle terraces; on open slopes with free drainage, meltwater channels and a rill complex develop; and in areas with irregular valley walls, kettled deltaic and stream terraces develop.—GDC

02361 **Funkhouser, John G.; Naughton, John J.** Radiogenic helium and argon in ultramafic inclusions from Hawaii: Jour. Geophys. Research, v. 73, no. 14, p. 4601-4607, tables, 1968.

Isotopic studies have been made of the inert gases present in ultramafic xenoliths from two sites in Hawaii, the 1800-1801 Kaupulehu flow (Hualalai Volcano, Hawaii) and Salt Lake Crater (Oahu). Apparent ages calculated from the measurement of radiogenic argon and helium have very high values. The ratio of radiogenic helium to argon relative to natural gases and to the value expected from generation in situ is low. From gas extraction by crushing and decrepitation, it is shown that the inert gases occur in fluid and gaseous inclusions in the minerals of the nodules. The gases are believed to be representative of the magmatic environment, with the low helium-to-argon ratio resulting either from preferential loss of helium or from generation of the gas from a source similar to a chondritic composition. The inert gas "ages", then, are of uncertain significance for these samples.—Authors' abstract

02531 **Funkhouser, John G.; Barnes, I. Lynus; Naughton, John J.** The determination of a series of ages of Hawaiian volcanoes by the potassium-argon method: Pacific Sci., v. 22, no. 3, p. 369-372, table, 1968.

Additional age measurements, 26 from Waianae Volcano on Oahu, and 7 from other scattered sites, are listed. Several anomalous ages due to excess radiogenic argon are discussed. Activity in Waianae seems to have spanned well over two million years.—ESL

02259 **Furley, Peter.** The University of Edinburgh British Honduras–Yucatán expedition: Geog. Jour., v. 134, pt. 1, p. 38–54, illus., tables, 1968.

Five months were spent in the region making a physical geography survey. Special emphasis was placed upon soil–slope transects, land–capability analysis, and a reconnaissance of the British Honduras karst region, heretofore largely uninvestigated. The nature of the weathering of the limestone and the granite terrains is described also. The karst area lies on Eocene and Cretaceous limestones which are comparatively much more evolved and dissected than the rest of the region. Residuals are very common and the limestones are much more broken down; the relief, as expected, is very low.—HRC

02494 **Furnish, W. M.** Zonal ammonoids of the Atokan Stage [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 116, 1968.

07481 **Fyles, James T.** Geology of the Ainsworth–Kaslo area, British Columbia: British Columbia Dept. Mines and Petroleum Resources Bull. 53, 125 p., illus., tables, geol. maps, 1967.

The map-area is in the central part of the Kootenay arc, adjacent to the Nelson batholith. Rocks ranging from Lower Cambrian to Upper Triassic and intruded by sills, lenses, and dikes, and regionally metamorphosed, are split by strike faults parallel to the foliation, forming four fault slices, whose lithology is described. The structural setting of the Ainsworth silver–lead–zinc deposits is the primary study. Isoclinal folds are the oldest structures in each slice and plunge north at a low angle; more open folds with the same plunge are also found. Ore occurs in shoots and lenses in quartz–carbonate veins forming three well-defined systems and some clusters. The vein systems are normal fault zones. Total production has been 763,858 tons of ore. Notes on the properties, including geology and some maps, comprise the last 47 pages.—ESL

Gabbey, Patricia. *See* Andrews, Henry. 02346

02397 **Gable, D. J.** Geology of the crystalline rocks in the western part of the Morrison quadrangle, Jefferson County, Colorado: U.S. Geol. Survey Bull. 1251-E, p. E1–E45, illus., tables, geol. map, 1968.

Underlying the western part of the Morrison quadrangle are strongly folded, regionally metamorphosed Precambrian igneous and metasedimentary rocks that reflect three periods of metamorphism. The oldest rocks are interlayered metasedimentary gneisses consisting principally of microcline gneiss, biotite gneiss, and hornblende gneiss that reflect metamorphism of high sillimanite grade. The youngest rocks, probably Tertiary in age, consist of dikes of diabase and latite and a small stock of shonkinite. The gneisses were intruded in Precambrian time by small plutons of granodiorite similar to the Boulder Creek granodiorite, followed by migmatization and emplacement of gneissic granodiorite. These intrusives predate the third period of metamorphism, which was marked chiefly by mild cataclasis and muscovitization. Economic materials consist solely of construction materials; uranium has been produced at Idledale.—DJG

Gabrielse, H. *See* Roddick, J. A. 07493

07373 **Gagliano, S. M.; Thom, B. G.** Deweyville terrace, Gulf and Atlantic Coasts: Louisiana State Univ. Coastal Studies Bull. 1 (Tech. Rept. 39), p. 23–41, illus., 1967.

The Deweyville river terrace lies between the late Pleistocene Prairie terrace and the Recent floodplain in the Gulf Coast. Type features from the Pearl and Trinity Rivers are compared with those of the Pee Dee, S.C., area. Discontinuous remnants 5 to 15 feet above the floodplain represent a surface graded to a lower base level than present; large meander scars and relict overflow channels also exist. In the

Pee Dee basin, two valleys possess large meander scars, but one shows braided topography. Deposits are dated at 17,000–36,000 yr in both areas. The Deweyville terrace is correlated with the high-level flood plain of the Mississippi alluvial valley, and probably formed during a rise in sea level in the Plum Point substage. Increase in precipitation during pluvials explains the large meander scars and overflow channels. Bankfull discharge would have had to be five to seven times greater than present.—ESL

02307 **Ganders, F. R.; Cridland, A. A.** Leaf cuticles of Miocene *Taxodium dubium* from central Washington [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 727, 1968.

07345 **Gardner, R. P.; Roberts, K. F.** Density and moisture content measurements by nuclear methods—Natl. Coop. Highway Research Program Rept. 43: Washington, D.C., Natl. Acad. Sci.–Natl. Research Council, Highway Research Board, 38 p., illus., tables, 1967.

Previously identified problems of nuclear density and moisture content gages (NCHRP Rept. 14) may be solved by developing for each gage calibration models that enable stable and homogeneous nonsoil standards to be used for calibration. In developing and testing the nuclear density model, the dual-gage principle of compensating these gages for variations in soil composition was discovered. The air-gap method of using this principle has been explained and optimized by using the calibration model developed in the current study. This calibration method should be used in conjunction with the air-gap method for routine field use of density gages; other dual-gage methods show promise of future improvement. The calibration method described should be used to calculate a single curve for average soil for field use of moisture content gages. The method for each gage is explained in two appendixes.—GDC

07504 **Geological Survey of Canada Officers; Brown, I. C.** (editor). Groundwater in Canada [with French abs.]: Canada Geol. Survey Econ. Geology Rept. 24, 228 p., illus., tables, 1967.

This account of occurrence, flow systems, and chemistry, relates ground water in Canada's six major hydrogeological regions to the geological materials through which it flows and to the hydrologic cycle; discusses principles and methods of hydrogeology and the methods, techniques, and formulae required for aquifer exploration and development. Much data are available for the Interior Plains and St. Lawrence Lowlands, where ground water is used extensively; less for the Appalachian, Canadian Shield, and Cordilleran regions, where surface waters are adequate for present demands; and little for the northern region of sparse population, where permafrost influences the role of ground water. The nine chapters by various authors are individually cited, with pertinent hydrogeologic maps in pocket.—GDC

02404 **George, P. T.; Leahy, E. J.** (compilers). Wark township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 478, scale 1 in. to 1/4 mi., text, 1968.

Rock outcrops are found in only about one percent of Wark township. Structural data combined with geophysical data indicate that most, if not all, of the rock formations strike N. 60° E. Rock types are mafic and felsic volcanic flows and pyroclastics, along with metasediments, all intruded by gabbro and serpentinite. Pillow and sedimentary tops do not provide enough information to determine fold axes. Movement on northwesterly-trending faults since intrusion of gabbro and serpentinite must have been essentially vertical. Mineral exploration has been unrewarding.—MCM

02240 **Gibb, R. A.** The densities of Precambrian rocks from northern Manitoba: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 433–438, illus., tables, 1968.

To assist in the interpretation of gravity anomalies in northern Manitoba and northeastern Saskatchewan, a part of the western Canadian Shield, the average densities of 2004 Precambrian rock samples, grouped according to rock type, are tabulated. Relatively positive anomalies may be expected over greenstone belts (2.85 g/cm^3), sedimentary gneisses (2.79 g/cm^3), granulites (2.73 g/cm^3), and mafic to

ultramafic intrusions—diorite (2.77 g/cm^3), gabbro (3.00 g/cm^3), and peridotite (3.19 g/cm^3), whereas negative anomalies may be expected over granitic rocks (2.64 g/cm^3). These results are consistent with results from other areas. The average composition of a slab of surface rock in this part of the western Canadian Shield is shown to be granodioritic with an average density of 2.67 g/cm^3.—Author's abstract

02241 **Gibb, R. A.** A geological interpretation of the Bouguer anomalies adjacent to the Churchill–Superior boundary in northern Manitoba: Canadian Jour. Earth Sci., v. 5, no. 3, pt. 1, p. 439–453, illus., table, 1968.

The Bouguer anomaly map of northern Manitoba and part of northeastern Saskatchewan was updated by a gravity survey in 1965. Density determinations of some 2,000 Precambrian rock samples provide a sound basis for interpretation of the Bouguer anomalies in terms of relatively near-surface mass distributions in the upper crust. In parts of the area there is excellent correlation between the surface rocks, their densities, and the Bouguer anomalies. As a result of this work, the Churchill–Superior structural province boundary may be moved south to what is at present the southern limit of the Cross Lake subprovince, which is a return to about the position originally selected by M. E. Wilson.—*from* Author's abstract

02187 **Gibson, L. B.; Clarke, R. T.** Floral succession and palynological correlation: Jour. Paleontology, v. 42, no. 2, p. 576–581, illus., 1968.

Plant successional trends are discussed as a means of stratigraphic correlation, based on palynomorph distributions. A succession is defined as replacement of one floral community by another in a given area. Changes in community composition follow changes in environment; consequently palynological evidence of floral changes can be expected in the sedimentary rock section. The degree to which successions are recorded and interpretable in a sedimentary sequence is effected by depositional environments, palynological productivity of plants, dispersal mechanisms, mixing, reworking, and many other complicating factors. These principles are applied in a case study of two Desmoinesian coals.—SHM

07323 **Gigl, Paul; Dachille, Frank.** Effects of pressure and temperature on the reversal transitions of stishovite [abs.]: Meteoritics, v. 3, no. 3, p. 111–112, 1967.

02416 **Giguere, J. F.** Granitehill Lake area, Districts of Thunder Bay and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 473, scale 1 in. to 1 mi., text, 1968.

The northernmost part of the Granitehill Lake area is crossed by a metasedimentary and metavolcanic belt having mineral assemblages characteristic of the amphibolite metamorphic facies. The southern section is underlain by a batholithic mass of granodiorite whose emplacement probably coincided with metamorphism of the older rocks. The area is cut by numerous gabbro and diorite dikes. Overlying drift is mostly fine sand in the northwest corner, changing to gravel over the remainder. Minor fold trends occur along east–west striking axes. Faults control locations and attitudes of some mafic dikes and have influenced trends of streams and locations of lakes. There is some mineralization within the metasediments, and although no sulfide zones were found, the northern belt warrants further study.—MCM

Gilbert, M. C. *See* Richardson, S. W. 02442

07335 **Gillerman, Elliot; Hill, Walter E., Jr.** The Belle Plaine III meteorite: Meteoritics, v. 3, no. 3, p. 147–150, illus., 1967.

The Belle Plaine III meteorite is one of three meteorites, all of about the same size, found within a 2 mile strip southeast of Belle Plaine, Kansas. The meteorite weighs 23.9 kg, and consists of about 28 percent metallic minerals and 72 percent silicates. Nickel-iron, magnetite, hypersthene and olivine are the major constituents. The meteorite is an olivine–hypersthene chondrite.—Authors' abstract

02576 **Glancy, Patrick A.; Rush, F. Eugene.** Water-resources appraisal of Smoke Creek–San Emidio Desert area, Nevada and California: Nevada Dept. Conserv.

and Nat. Resources Water Resources—Reconn. Ser. Rept. 44, 57 p., illus., tables, 1968.

Precipitation within the Smoke Creek–San Emidio Desert area is assumed to be the source of practically all water. Geologic terrane controlling the natural hydrologic system consists mainly of consolidated-rock mountain masses bordering and separating the valleys, and alluvial-mantled valley floors. Mountain ranges and intervening basins are the result of structural deformation of the Earth's crust that set the gross hydrologic framework. Principal known and developed aquifers occur in alluvial deposits, at relatively shallow depths. Knowledge is unavailable about presence, size, or quality of water reservoirs at great depths in alluvium or consolidated rocks. Chemical analyses of 25 water samples show quality ranges from good to very poor. Future development may depend upon whether quantity and quality of available water are adequate for intended use.—*from* Authors' abstract

Glass, H. D. *See* Frye, John C. 02340

Glass, H. D. *See* Frye, John C. 02533

Glasser, F. P. *See* Dent Glasser, L. S. 02201

07522 **Gobbett, D. J.** Palaeozoogeography of the Verbeekinidae (Permian foraminifera), *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 77–91, illus., 1967.

Foraminifera of the family Verbeekinidae are largely restricted to Middle and lower Upper Permian limestones of the Tethyan region. The morphology of the verbeekinid test suggests that parallel evolution of the septula and reduction of the keriotheca occurred. It is inferred that adults were benthic in warm, shallow, clear water rich in algae, extensive migration within the Tethys possibly effected by planktonic young stages. In the stratigraphic and wide geographic distribution of species groups, three successive verbeekinid faunas are shown to have inhabited the Old World Tethys, the last migrating to North America and New Zealand. The present distribution of the Verbeekinidae is difficult to explain in terms of a circumequatorial sea unless extensive drifting of the sialic crust has occurred since Permian.—*from* Author's abstract

07369 **Gold, L. W.** Time to formation of first cracks in ice, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 359–370, illus., table, 1967.

This study has indicated that the formation of cracks in ice is a thermally activated process. The amount of creep strain that occurs to the formation of the first large crack for a given applied compressive stress appears to be largely independent of temperature. This suggests that the process or processes controlling creep behavior are associated also with the nucleation of cracks. The characteristics of the initial part of the crack-forming process are consistent with dislocation models of crack nucleation discussed by Stroh (1957) and Bullough (1964). Dislocation cracks can nucleate Griffith cracks when the maximum applied shear stress (assumed equal to one-half of the applied compressive load) is about 3.43×10^6dyn/cm^2. Internal cracks do not form when the maximum applied shear stress is less than about 2.5×10^6dyn/cm^2.—Author's conclusions

07383 **Goodman, R. H.** A multi-spectrometer Mössbauer system using an on-line computer, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 175–196, illus., 1967.

Use of a small on-line computer for constant-acceleration experiments, and a system of sequentially controlling experiments and monitoring parameters are described. Interface techniques of computer and Mössbauer spectrometer are given, and relative merits of several different approaches compared. Application of this system is illustrated by a study of certain iron-copper-sulfur compounds, including chalcopyrite. The programming is given in the appendixes.—*from* Author's abstract

07350 **Gordon, R. B.** Inelasticity of crystalline rock at high pressure—Application to tidal friction and seismology—U.S. Office Naval Research Contract ONR 609(54), Tech. Rept. 4: New Haven, Conn., Yale Univ., Dept. Eng. and Appl. Sci., 13 p., illus., 1967.

The inelastic response of igneous and metamorphic rocks to alternating stress has been measured at low frequency under hydrostatic confining pressure. The inelasticity is characterized by an internal friction and modulus defect that are quite pressure sensitive. It is shown from the laboratory data that no significant contribution to the observed tidal friction is expected from the solid earth and that partial melting will result in a low velocity, low Q zone in the mantle.—Author's abstract

Gormsen, K. *See* Bridgwater, D. 02242

02256 **Goss, D. W.; Allen, B. L.** A genetic study of two soils developed on granite in Llano County, Texas: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 409–413, illus., tables, 1968.

Studies were made of well-drained soil (Click) and a poorly drained soil (Bauman), to determine the effects of topography upon their genesis and resulting mineralogy. Heavy mineral data indicate that the soils have developed from homogeneous parent materials. Clays were fractionated for X-ray diffraction, differential thermal, and cation-exchange capacity studies. The data indicate that montmorillonite dominates the fine clay of the Bauman soil, while the fine clay fraction of the Click soil contains near equal portions of kaolinite, illite, montmorillonite, and X-ray amorphous material. Exchangeable Na is present in the subsoil of the Bauman profile but is absent in the Click soil. Weathering products from the surrounding slopes have moved laterally at the soil–unweathered granite interface and accumulated in the Bauman soil thereby causing its morphology and clay mineralogy to differ markedly from the Click soil.—*from* Authors' abstract

Graham, E. R. *See* Clarke, A. L. 02221

Grantz, A. *See* Allen, C. R. 02580

02585 **Green, L. H.; Roddick, J. A.; Blusson, S. L.** Geology, Nahanni, District of Mackenzie and Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 8-1967 (supersedes part of Map 14-1961), scale 1:253,440, text, 1968.

The Nahanni area has been extensively glaciated to at least 6,500 feet elevation. Paleozoic strata range from a Cambrian and earlier succession of argillaceous to pebbly rocks to Devonian and Mississippian(?) black shale and argillite. Granitic intrusions are discordant, nonfoliated, essentially free of inclusions, and have well-defined, steeply-dipping contacts; all contain, in part, abundant megacrysts of potash feldspar. Regional fold axes trend dominantly northwest; intensity of folding increases generally from northeast to southwest and south. Two prominent reverse faults in the northeastern section appear to have appreciable left-lateral components to account for offset of facies and deflection of major fold zones. Most intrusive bodies have some indications of mineralization adjacent to them, especially in associated carbonate rocks.—MCM

Greene, H. G. *See* Scholl, D. W. 02284

07398 **Gregor, Tomáš.** Poznámky ku genéze a tektonickému postaveniu niektorých Mn ložísk na Kube [with English abs.]: Geol. Práce, Zpravy no. 43, p. 179–195, illus., 1967.

These notes on the genesis and tectonic position of the manganese deposits of Balkanes and Los Chivos in Cuba show that fine-structural elements are closely related to the megatectonic. Schistosity, cleavages, and overthrusts are connected with folding. The deposits outcrop in several horizons of the volcanic-detrital formation, but do not form a continuous horizon; they occur with silica and seem to have had the same syngenetic origin. The ore-forming components might have been cemented by pyroclastic material in a marine environment. The deposits were

affected by the folding, and structural elements connected with them cast light on tectonic chronology. Those elements evoked by compression and those by tension are distinguished. Grabens interrupt the folds and some faults are diagonal to fold structure.—ESL

07385 **Gribi, Edward A., Jr.** Ancient shorelines of the Gabilan uplift, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Sec., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 87–91, illus., 1967.

Three isopach maps, restored to conditions at least prior to Quaternary diastrophism, are presented to show the development of Tertiary basins and shorelines in the area of the Gabilan uplift of California. They show pre–upper Miocene marine rocks, upper Miocene marine rocks, and Pliocene rocks, with oil and gas accumulations. Tertiary geologic history is described and the relation of oil and gas accumulation to it is reviewed.—ESL

Griffin, Margaret S. *See* Weld, Betsy A. 02593

02440 **Griffin, W. L.; Murthy, V. Rama; Phinney, W. C.** Reply to [discussion by S. R. Hart of "K/Rb in amphiboles and amphibolites from northeastern Minnesota" (1968)]: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 31–32, 1968.

General agreement is found with the criticisms developed in the discussion (ibid., p. 30–31), and an explanation as to the sources of certain assumptions is offered.—HRC

07465 **Griffin, William L.** Provenance, deposition, and deformation of the San Benito Gravels, California, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 61–73, illus., tables, 1967.

The San Benito Gravels are Pliocene–Pleistocene continental deposits in the Coast Ranges south of Hollister, folded and faulted during the late Pleistocene. A brown-sand and a white-sand facies can be distinguished. Gravels make up 25–35 percent of the former and 20–25 percent of the latter; pebble counts and sand composition are tabulated for both. Current and crossbedding features in the white-sand facies indicate deposition by a braided river, while the brown-sand facies represent sediments of a piedmont alluvial slope. Pleistocene paleogeography is reconstructed to determine gravel provenance. Bedrock was folded and faulted during six orogenic periods betwee the Cretaceous and the present; the southeastern end of the basin underwent progressive differential uplift. Strike-slip movement along nonparallel faults caused much of the late Pleistocene deformation, and is continuing.—ESL

Gronberg, E. C. *See* Johnson, J. G. 02194

Grossman, Irving G. *See* Cervione, Michael A., Jr. 02430

Gude, Arthur J., 3d. *See* Sheppard, Richard A. 02592

Guillard, R. R. L. *See* Deuser, W. G. 02341

Gupta, Y. P. *See* Santhanam, A. T. 02353

02506 **Habib, Daniel.** Spore and pollen paleoecology of the Redstone seam (Upper Pennsylvanian) of West Virginia: Micropaleontology, v. 14, no. 2, p. 199–220, illus., 1968.

Spore and pollen assemblages occurring in an Upper Pennsylvanian Redstone coal seam are used to interpret phytoecological history of the swamp in which source material was deposited. *Punctatosporites minutus* and other bilaterally symmetrical monolete spore species predominate through the thickness of the seam, masking vertical variation of other more significant species. With their removal, additional assemblages were recognized, some of which correspond closely to variations in maceral content of the seam. As a result, three phases in the ecological development

of the Redstone coal were distinguished. Forty-nine sporomorph species in 34 genera were recognized, 10 species and one genus, *Stripites*, being new. *Densosporites* and *Cristatisporites* are reported for the first time from an Upper Pennsylvanian coal seam in the United States.—*from* Author's abstract

Hacquebard, P. A. *See* Barss, M. S. 07407

Hadley, R. F. *See* Emmett, W. W. 02594

02278 **Haffty, Joseph; Riley, Leonard B.** Determination of palladium, platinum, and rhodium in geologic materials by fire assay and emission spectrography [with French and German abs.]: Talanta, v. 15, no. 1, p. 111–117, tables, 1968.

A method is described for the determination of palladium down to 4 ppb (parts per billion, 10^9), platinum down to 10 ppb and rhodium down to 5 ppb in 15 g of sample. Fire-assay techniques are used to preconcentrate the platinum metals into a gold bead, then the bead is dissolved in *aqua regia* and diluted to volume with 1*M* hydrochloric acid. The solution is analyzed by optical emission spectrography of the residue from 200 μl of it evaporated on a pair of flat-top graphite electrodes. This method requires much less sample handling than most published methods for these elements. Data are presented for G-1, W-1, and six new standard rocks of the U.S. Geological Survey. The values for palladium in W-1 are in reasonable agreement with previously published data.—Authors' abstract

Hales, A. L. *See* Bloch, S. 02244

02316 **Hall, J. W.** A Cretaceous *Azolla* megaspore with many floats [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 724, 1968.

07511 **Halstead, E. C.** Cordilleran hydrogeological region, Chap. 7 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 159–172, illus., tables, geol. map, 1967.

This region, mostly in British Columbia, includes three major northwest-trending systems. In the Western, island ranges are isolated by lowlands; the high St. Elias and Coast Mountains nourish alpine glaciers and ice fields, as do the Rocky Mountains in the Eastern system. The Interior system is a 200-mile-wide belt of ranges and lava plateaus. Geologically complex rocks, Precambrian to Recent, have joints, fractures and fault zones common to all. In much of the area, where surface waters supply scattered lumber, fishing, and mining camps, ground-water potential is unknown, although its movement is apparent at many bedrock springs, some of them thermal. Pleistocene drift and outwash from continental ice sheets provide best recharge and storage basins. In lowlands, water supply is augmented by artesian waters.—GDC

07352 **Hamblin, W. K.; Howard, James D.** Physical geology—Laboratory manual (2d edition): Minneapolis, Minn., Burgess Publishing Co., 180 p., illus., tables, 1967; originally published 1964.

This manual follows the same format as the 1964 edition, but presents several new techniques in study material. Color photographs of minerals, rocks, and thin sections have been added; many cultural symbols were removed from topographic maps to aid study of landforms; exercises are revised to emphasize geologic principles; map selection has been changed and increased; eight full-color geologic maps have been added; and 16 aerial photographs, two of radar imagery, are included.—ESL

Hamilton, Edwin L. *See* Richards, Adrian F. 07393

Hampel, J. *See* Carmichael, I. S. E. 02511

Hanneman, R. E. *See* Strong, H. M. 07441

07516 **Hansen, Henry P.** Chronology of postglacial pollen profiles in the Pacific Northwest (U.S.A.), *in* Quaternary palynology and actuopalynology: Rev. Palaeobotany and Paynology, v. 4, nos. 1–4, p. 103–105, table, 1967.

Composite pollen profiles from many peat sections in the Pacific Northwest showing postglacial forest sequences are correlated in a table with radiocarbon-dated pumice and ash. The "thermal interval" is shown from 8,000 to 4,000 years ago. A bibliography is added of papers by the author which are relevant to this subject.—Author's abstract

02486 **Hansen, Michael C.** The upper Paleozoic genus *Petalodus* (Bradyodonti) from North America [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 19–20, 1968.

02186 **Hansman, Robert H.** *Choanoceras?* from the Middle Silurian of Ontario: Jour. Paleontology, v. 42, no. 2, p. 575–576, illus., 1968.

The holotype and only reported specimen of *Orthoceras? attawapiskatense*, from the Middle Silurian of Ontario, is restudied and described; the species is tentatively placed in the genus *Choanoceras*.—JP

02562 **Harbaugh, John W.; Merriam, Daniel F.** (compilers). Computer applications in stratigraphic analysis: New York, John Wiley and Sons, 282 p., illus., tables, 1968.

To explain and illustrate some principal methods of analysis of stratigraphic data by electronic digital computers, emphasis is placed on techniques useful in stratigraphic and structural problems involving spatial relationships in sedimentary basins. Applications selected illustrate use of methods widely applied by geologists, and used by the authors in the Midcontinent region of the United States, particularly in Kansas. Most have relevance to petroleum geology, and many involve mapping. Those largely statistical have been excluded. Envisioned as a reference work, this book may find use as a textbook, and be helpful to exploration geologists or in fields outside geology. Seven of the eight chapters discuss information systems, mapping techniques, time-trend analysis, polynomial trend analysis, harmonic trend analysis, classification systems, and simulation.—GDC

02251 **Harris, F. R.** Geology of the Saganagons Lake area, District of Thunder Bay: Ontario Dept. Mines Geol. Rept. 66, 30 p., illus., geol. map, 1968.

All bedrock is Precambrian in age, consisting of paragneiss and metavolcanics, which have been intruded by diorite, gabbro, basalt porphyry, and serpentinized peridotite. The metavolcanics form two east to northeast-trending belts. Two granite batholiths, of different composition, are intrusive into the above rock types. The youngest rocks are feldspar-quartz porphyry, diabase and lamprophyre dikes. The area contains three easterly to northeasterly-trending faults, and several northwesterly-trending faults. Top determinations indicate that the metavolcanics face north. The metavolcanics contain quartz veins with low values in gold, and discontinuous narrow bands of iron formation. On the northwest shore of Home Lake, copper mineralization in rhyolite was found during the 1965 field season. A chip sample taken by the author across 5 feet assayed 1.24 percent copper.—*from* Author's abstract

02509 **Harris, Stuart A.** Till fabrics and speed of movement of the Arapahoe Glacier, Colorado: Prof. Geographer, v. 20, no. 3, p. 195–198, illus., 1968.

Pebble orientation in tills of southern Ontario may indicate speed as well as direction of ice movement. Surface speed near the terminus of the receding Arapahoe Glacier near Nederland, Colo., is known. From the till between its ice margin and last moraine, at each of three equally elevated sites, 50 elongated pebbles were used to check horizontal direction and angle of dip of the longest and intermediate axes. Plotted on a rose diagram, primary modes were consistently normal to ice margin. Till fabrics were not obviously related to morphology or lithology of the pebbles; absence of pockets of differently oriented pebbles was noted. The pebbles tend to dip about 10° into the depositional surface, pointing away from ice margin.

Bottom zone speed in past ice sheets may possibly be measured from the degree of pebble orientation in ground moraines.—GDC

07526 **Harrison, W.; Richardson, A. M., Jr.** Plate-load tests on sandy marine sediments, lower Chesapeake Bay, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 274–290, illus., tables, 1967.

Two plate-bearing tests were made 1.8 nautical mi west of Little Creek Harbor entrance in 16 to 20 ft of water. A 41-ton load frame, constructed to ensure adequate reaction for each jack load, was emplaced by the USS *Salvager*; divers from the ship conducted tests according to telephoned instructions from the deck. Bearing capacity factors ($N\gamma$) for use in Terzaghi's bearing capacity equation, estimated at 62 for site A and 195 for site B, are somewhat higher than would have been estimated on the basis of triaxial tests on sand. Average coefficients for subgrade reactions of 50 and 110 tons per cu ft were obtained at sites A and B, respectively; these compare favorably with values proposed for medium to dense submerged sands. Future research should be directed toward development of a standard penetration sampling test for use in the marine environment and calibrated against further in-place load tests.—*from* Authors' abstract

02466 **Hart, Stanley R.** Discussion *of* "K/Rb in amphiboles and amphibolites from northeastern Minnesota," by W. L. Griffin, V. R. Murthy, and W. C. Phinney [1968]: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 30–31, 1968.

Some of the original authors' conclusions (ibid., v. 3, no. 4, p. 367–370, 1968) are considered equivocal because of certain basic assumptions regarding the K-Rb ratios' activities under the circumstances described.—HRC

02302 **Haubrich, Richard A.** Array design: Seismol. Soc. America Bull., v. 58, no. 3, p. 977–991, illus., tables, 1968.

Arrays of detectors placed at discrete points are often used in problems requiring high resolution in wave number for a limited number of detectors. The resolution performance of an array depends on the positions of detectors as well as the data processing of the array output. The performance can be expressed in terms of the "spectrum window". Spectrum windows may be designed by a general least-square fit procedure. An alternate approach is to design the array to obtain the largest uniformly spaced coarray, the set of points which includes all the difference spacings of the array. Some designs obtained from the two methods are given and compared.—Author's abstract

Hay, Richard L. *See* Iijima, Azuma. 02217

02253 **Hay, Richard L.; Iijima, A.** Petrology of palagonite tuffs of Koko Craters, Oahu, Hawaii: Contr. Mineralogy and Petrology, v. 17, no. 2, p. 141–154, illus., tables, 1968.

The tuff deposits consist of alkali basalt glass, progressively palagonitized at depth. Principal authigenic minerals were deposited in the sequence: phillipsite, chabazite, analcime, montmorillonite together with opal, and calcite; as the amount of these minerals is proportional to that of palagonite, they must have been produced during palagonitization. Electron microprobe analyses of sideromelane and associated palagonite show that a fourth of the SiO_2, half the Al_2O_3 and MgO, and three-fourths of the CaO, Na_2O, and K_2O are lost in converting sideromelane to an equal volume of palagonite; these are mostly precipitated as zeolites, montmorillonite, opal, and calcite. The pH and ionic strength of percolating water increased with depth by solution of glass, and where sufficiently high, glass reacted to form palagonite and zeolites. Palagonite formed by a microsolution-precipitation mechanism.—ESL

02573 **Haye, Edward F.** Gravity can slash costs in search for pinnacle reefs: Oilweek, v. 19, no. 21, p. 17–20, 22–24, illus., 1968.

Gravity effectiveness in locating reefs varies between areas, even in the same trends and geological provinces. If seismic tests of gravity leads find no reef relations, a dense seismic grid is needed. Comparison of anomalies in Illinois, Saskatchewan, and south-central Texas, indicates: reefs are generally associated with positive anomalies, even when less dense than surrounding material; without salt, density contrast and volume are insufficient to recognize anomaly from reef level; an above reef anomaly is due to draping bedded contrasts and lateral changes in density; there may be no shallow maximum depth estimates; gravity is sensitive to changes in salt thickness and in much of Canada is suitable for finding pillows and solution channels; an inexpensive pilot project, rather than theoretical computation of anomalies, is the only practical evaluation method.—GDC

02334 **Hayes, Dennis E.; Heirtzler, James R.** Magnetic anomalies and their relation to the Aleutian Island arc: Jour. Geophys. Research, v. 73, no. 14, p. 4637–4646, illus., 1968.

Magnetic lineations trending approximately east–west are found south of the Aleutian trench and are mapped as far west as 173° E. Near 165° W. they are continuous with those of the Great Magnetic Bight of the northeast Pacific. The pattern is offset in a north–south direction in one or more places. The lineations northeast of the Japan trench were probably formed before Late Cretaceous, prior to formation of lineations adjacent to and south of the Aleutian trench. Magnetic anomaly profiles across the Aleutian trench are characterized by a "quiet zone" of small-amplitude anomalies about 100 km wide, centered near the trench axis; the zone apparently does not result solely from the geometry of the trench. A two-dimensional magnetic model is presented that could account for the observed anomaly pattern. With qualifications, the model is consistent with the hypothesis of sea-floor spreading.—*from* Authors' abstract

Hays, W. H. *See* Hobbs, S. W. 02246

Hazen, Scott. *See* Waterman, Glenn C. 02389

02546 **Heald, Emerson F.** Graphical representation of homogeneous chemical equilibria in volcanic gas systems: Am. Jour. Sci., v. 266, no. 5, p. 389–401, illus., tables, 1968.

The logarithms of the partial pressures of the components of the gaseous phase are plotted against the logarithm of the partial pressure of the oxygen under conditions of constant temperature, constant total pressure, and constant ratios of all elements except oxygen. The result is a quantitative survey of the effect of oxidation on the gases present. The equilibrium composition of an individual volcanic gas sample or of any mixture of gases may be obtained from the diagram when the atomic ratio of the oxygen is also fixed. In constructing logarithmic partial pressure diagrams, it is essential to know which molecular species may become dominant (contain virtually all of a certain element) under the conditions of the diagram.—*from* Author's abstract

07381 **Heath, R. L.** Review of solid-state detector systems for X-ray spectrometry, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 424–441, illus., 1967.

Recent developments in fabrication techniques for lithium-ion drifted germanium and silicon detectors and low-noise electronics have resulted in improved performance for X-ray and gamma-ray spectrometers. A review of characteristics of detectors and associated electronic systems for use in X-ray spectrometry includes a description of optimum operating parameters for detectors, design of low-noise preamplifiers employing field-effect transistors, instrumental requirements for high-resolution systems, and methods which can be applied for data analysis. Practical laboratory X-ray spectrometer systems using commercially available equipment are described. Data presented were obtained on a system exhibiting an energy resolution of 420 eV (FWHM) for 6-keV photons; practical examples of the application to X-ray spectrometry are presented.—*from* Author's abstract

02476 **Heezen, Bruce C.** The Atlantic continental margin, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt-Geology Dept. Colloquium Ser. 1), p. 5–25, illus., 1968.

Currents carry detritus across the continental shelf to the adjacent continental slope where slumps and turbidity currents transport the sediment downslope for hundreds of miles, and deep geostrophic contour currents transport it thousands of miles down-current in a direction parallel to the bathymetric contours. The combined effect of these processes has been to create a wide, thick, geosynclinal apron of sediment at the base of the continental slope. Subsidence has continued since mid-Mesozoic, carrying down Lower Cretaceous reefal limestones to depths of 5,000 meters off Florida. The subsidence of the Atlantic continental margin and the basement of the continental rise geosyncline apparently commenced in mid Mesozoic time with the creation of abyssal depths in the steadily expanding Atlantic.—*from* Author's abstract

Heim, G. E., Jr. *See* Howe, W. B. 02313

Heirtzler, James R. *See* Hayes, Dennis E. 02334

02495 **Helsley, Charles E.** Paleomagnetism of Cretaceous rocks from North America [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 116–117, 1968.

Hemenway, Curtis L. *See* Patashnick, Harvey. 07436

02496 **Henbest, Lloyd G.** Microfossils and integrated faunal and sedimentary cycles in the Atoka Series (Pennsylvanian) near Winslow, Arkansas [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 117, 1968.

Henderson, E. P. *See* Buchheit, R. D. 07453

07475 **Henke, Burton L.** Techniques of low energy X-ray and electron physics—50 to 1000 ev region, *in* Symposium on low-energy X- and gamma sources and applications, 2d,Austin, Tex., 1967, Proc., V. 2: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 522–556, illus., 1967.

Some of the methods and instrumentation developed in the laboratory of the Department of Physics, Pomona College, in the last ten years include the adaptation of a standard vacuum spectrograph to ultrasoft X-ray spectroscopy and a new tank design in development of multilayer systems for long wavelength analyzers. Applications of this system are: light-element determination, valence band analysis, photoelectric cross-section measurements, total reflection analysis, microradiography, and X-ray diffraction. Electron excitation methods are compared and the modifications necessary are described.—ESL

07360 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of Yukon Territory and District of Mackenzie: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1967.

On the reverse side of the map, source maps of Yukon Territory, Mackenzie, and adjacent portions of Alaska, and meteorological stations and snow courses are listed.—MCM

07361 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of northern British Columbia and southeastern Alaska: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1967.

On the reverse side of the map, source maps for British Columbia and Alaska, meteorological stations, and snow courses are listed.—MCM

02248 **Herreid, Gordon.** Farewell progress report [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 55 [1968].

02336 **Herron, E. M.; Dorman, J.; Drake, C. L.** Seismic study of the sediments in the Hudson River: Jour. Geophys. Research, v. 73, no. 14, p. 4701–4709, illus., tables, 1968.

Seismic refraction and borehole data obtained in the Hudson River near Nyack, N. Y., have shown that two horizons of unconsolidated sediment lie above the Triassic sandstone. The lower horizon, made up of unsorted clastic material, has a compressional velocity slightly greater than that of the water, whereas the upper layer, composed mainly of organic silt, has a compressional velocity less than half as great. During a seismic refraction experiment, two prominent wave trains were recorded: a high-velocity leaking mode and a very slow, long-period normal mode. The dispersion of the latter is controlled primarily by the shear velocity structure of the organic silt layer. The final model obtained fits seismic and borehole data and appears to represent reasonable variations of the physical properties of the sediments.—*from* Authors' abstract

Hessin, T. D. *See* Ketner, K. B. 02595

Hessin, Thomas D. *See* Wrucke, Chester T. 02584

02514 **Hewitt, D. F.** Phlogopite mica in Ontario: Ontario Dept. Mines Mineral Resources Circ. 8, 85 p., illus., 1968.

This mineral resources circular briefly describes 160 phlogopite mica deposits in Ontario, mainly situated in the Sydenham and Perth areas of southeastern Ontario. Production of mica began in Ontario about 1860 and has continued up until the present time with a total production of 97,107,210 pounds valued at 4,571,977 dollars since 1886. About 60 percent of the Ontario production of mica has been phlogopite, the remainder being muscovite. [The principal type of deposit is the metamorphic pyroxenite type, of which there are several varieties.]—Author's abstract

02569 **Hewitt, D. F.** Some aspects of environmental geology: Ontario Dept. Mines Indus. Mineral Rept. 26, 19 p., illus., tables, 1968.

Environmental geology deals with the interrelationships of the geological environment and the human community. Four spheres in which geological planning is necessary are: development of essential mineral resources and insurance of an adequate supply of construction materials, waste disposal sites, water supply and control of pollution and contamination, and engineering studies of foundations and all land uses that involve the nature of the basement. An example of urban expansion is the Toronto–Hamilton area. The aim of the planner should be a multiple or sequential use of the land, first exploiting sand and gravel or stone resources and later rehabilitating the land for building or other purposes. Production figures for construction materials within a radius of 60 miles from Toronto are tabulated for the years 1950 to 1966; sources are indicated on a sketch map of bedrock formations.—GDC

Hey, M. H. *See* Moss, A. A. 07455

Heymann, D. *See* Mazor, E. 07329

Heymann, Dieter. *See* Kruger, S. T. 02358

02568 **Hietanan, Anna.** Belt Series in the region around Snow Peak and Mallard Peak, Idaho: U.S. Geol. Survey Prof. Paper 344-E, p. E1–E34, illus., tables, geol. maps, 1968.

Snow Peak and Mallard Peak areas provide a clearer and more complete account of various geologic events in the northwestern contact aureole of the Idaho batholith than do the areas studied previously (Hietanen, 1962, 1963). The normal stratigraphic sequence of the five lowest formations of the Precambrian Belt Series (well exposed in many localities) allows correlation with known equivalents farther north with greater certainty. All metamorphic zones are represented in the report area and two episodes of recrystallization are evident. Many structural features change with grade of metamorphism and with material folded. Structure is

complicated by two to three sets of folds whose axes intersect at angles of 60–80° and which range in size from minute wrinkles to large folds having wave lengths of several miles. Several high-angle faults interrupt the stratigraphic and structural continuity.—*from* Author's abstract

07374 **Higashi, Akira.** Ice crystal growth in a temperate glacier in Alaska, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 409–430, illus., tables, 1967.

The 1960 Hokkaido University expedition studied the growth of ice crystals in Mendenhall Glacier, from the snowfield to the terminus. Concentration in direction of the *c*-axes was observed in areas where strong shear stresses existed. Foliation in these areas consisted of rows of fine grains recrystallized under stress, so that stress was considered as limiting growth. The 1964 expedition found a band of large single crystals in the lower glacier, and discovered that it was in a transition zone between compression at the foot of an ice fall and tension due to expansion of the glacier. It was concluded that exaggerated growth of ice crystals in a temperate glacier is accelerated by strain annealing.—ESL

Hill, Walter E., Jr. *See* Gillerman, Elliot. 07335

02409 **Hinrichs, E. Neal.** Geologic map of the Camp Desert Rock quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-726, scale 1:24,000, sections, 1968.

Hintze, Lehi F. *See* Rigby, J. Keith. 07434

Hintze, Lehi F. *See* Utah Geological Society. 07456

02246 **Hobbs, S. W.; Hays, W. H.; Ross, R. J., Jr.** The Kinnikinic Quartzite of central Idaho—Redefinition and subdivision: U.S. Geol. Survey Bull. 1254-J, p. J1–J22, illus., 1968.

The Kinnikinic Quartzite as defined by C. P. Ross in the Bayhorse region, Idaho, is here subdivided into six formations. The name Kinnikinic is restricted to an uppermost 700-ft-thick quartzite unit, which is definitely Middle Ordovician. The apparently conformable sequence below the Kinnikinic consists of 700 feet of Ella Dolomite (new name) of early Middle Ordovician age, and at least 2,000 feet of feldspathic, undated Clayton Mine Quartzite (new name). A second sequence, tectonically juxtaposed to the Kinnikinic-Ella-Clayton Mine sequence, underlies definitely Middle Cambrian shale and siltstone. The upper 1,200-ft-thick Cash Creek Quartzite (new name) of this sequence is underlain by 600 feet of dolomite and shaly limestone. A basal 400 feet of quartzite is terminated by a fault.—SWH

Hodge, Paul W. *See* Wright, Frances W. 07449

Hodgson, John H. *See* Stevens, Anne E. 02295

02413 **Hoffer, F. B.** Bibliography of Virginia geology and mineral resources—1941-1949: Virginia Div. Mineral Resources Inf. Circ. 14, 58 p., 1968.

07418 **Hoffman, James I.** Evidence of an organic influence on sediment diagenesis in the Mesaverde Group: Compass, v. 45, no. 1, p. 11–16, illus., table, 1967.

Petrographic analysis of 85 thin sections from a core cut in the Mesaverde Group, Hayden Gulch, Colorado, integrated with X-ray analysis, indicates a close relationship between carbonate cement and residual organic matter. Organic complexing of calcium and magnesium ions is suggested as the dominant factor in the cementation of these sediments by a dolomite-rich cement. No evidence was found for precipitation of dolomite by plant life near the sediment-water interface. Mineralogic and geochemical implications favor a marginal marine environment of deposition for this facies of the Mesaverde Group.—Author's abstract

Hole, F. D. *See* Borchardt, G. A. 02262

Hole, F. D. *See* Allan, R. J. 02263

Hole, Francis D. *See* Olson, Gerald W. 02277

02200 **Holm, J. L.; Kleppa, O. J.** Thermodynamics of the disordering process in albite: Am. Mineralogist, v. 53, nos. 1–2, p. 123–133, illus., tables, 1968.

The enthalpies of solution, in lead–cadmium–borate at 700°C, of samples of Amelia albite heated for 0–35 days at 1045±5°C have been measured. For the transformation low to high albite at 700°C, we obtained a change in enthalpy of 3.4±0.25 kcal per mole. The enthalpy of solution data indicates that change from low to high albite takes place in two steps. The first step, complete after three days at 1045°C, is associated with an enthalpy change of about 2.4 kcal per mole; the second step of about 1 kcal per mole was nearly complete after three weeks at 1045°C. We attribute the first step in the transformation to partial disordering of Al+Si atoms to form an "intermediate" albite. Calculated transformation temperatures are consistent with the work of McConnell and McKie, who suggested the existence of a "smeared" polymorphic transformation around 600°C.—*from* Authors' abstract

07483 **Holman, J. Alan.** A small Miocene herpetofauna from Texas: Florida Acad. Sci. Quart. Jour., v. 29, no. 4, p. 267–275, illus., 1967.

This fauna is of interest because records of Miocene amphibians and reptiles in North America are so few. The site is within the Flemming Formation on the western bank of the Trinity River, northeast of Cold Spring, San Jacinto County. Systematic descriptions are given of two salamanders, two frogs, a crocodilian, a lizard, and two snakes. All of the six genera identified have living representatives, but the two forms discussed at the specific level are extinct.—ESL

02428 **Holmes, G. William; Foster, Helen L.** Geology of the Johnson River area, Alaska: U.S. Geol. Survey Bull. 1249, 49 p., illus., tables, geol. map, 1968.

Vegetation, topography, and geology of the Johnson River area are representative of eastern interior Alaska, an area of alpine peaks, rolling foothills, broad lowlands, and unglaciated uplands. The bedrock consists of metamorphic rocks of Precambrian(?) age, Cretaceous igneous rocks, and small deposits of Tertiary age. Most of the terrain is covered by glacial drift including deposits of plateau glaciers, piedmont glaciers, valley glaciers, and small modern glaciers. Other phenomena of Recent age include rock glaciers, talus, rubble, colluvium, terrace deposits, fans, flood-plain deposits, organic silt, sand dunes, loess, beach ridges, and pingos. GWH

02431 **Hood, J. W.; Waddell, K. M.** Hydrologic reconnaissance of Skull Valley, Tooele County, Utah: Utah Dept. Nat. Resources Tech. Pub. 18, 57 p., illus., tables, 1968.

The main ground-water reservoir in Skull Valley in unconsolidated Tertiary and Quaternary rocks, underlies about 230,000 acres; the drainage basin includes about 800 sq mi. The source of all water is precipitation. Estimated average recharge and discharge is 30,000–50,000 acre-feet per year. Discharge is by evapotranspiration, wells, surface outflow, and underflow from the mouth of the valley. Estimated perennial yield of ground water is 10,000 acre-feet or less; any excess would be from storage. Chemical quality of water limits potential development; concentration of dissolved solids is 98–17,200 ppm. A considerable part of the water is saline; freshest water comes from streams and springs in the Stansbury Mountains.—*from* Authors' abstract

Hopkins, David M. *See* Scholl, D. W. 02284

02285 **Hopkins, David M.** Placer prospects in north Bering Sea [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 56–57 [1968].

02448 **Howard, J. H.** The use of transformation constants in finite homogeneous strain analysis: Am. Jour. Sci., v. 266, no. 6, p. 497–506, illus., table, 1968.

The four transformation constants of two-dimensional finite homogeneous strain relate the position of a point within a two dimension reference system before strain to its position after strain. Conversely, knowledge of the position of points before and after strain permits calculation of the transformation constants. The size, shape, and orientation of the strain ellipse, which graphically portrays the state of strain, are functions of the transformation constants and can be computed when the transformation constants have been determined. This article presents a method for determining these constants and also illustrates their use by a hypothetical example (a sheared crystal) and by two real examples (a deformed spirifer and a stretched belemnite).—Author's abstract

Howard, James D. *See* Hamblin, W. K. 07352

02313 **Howe, W. B.; Heim, G. E., Jr.** The Ferrelview Formation (Pleistocene) of Missouri: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 42, 32 p., illus., tables, 1968.

The name Ferrelview is applied to upland clayey silt present above oxidized Kansan till and below Illinoian Loveland Loess in northwestern Missouri. The Ferrelview is clearly late Kansan and Yarmouthian but may have extended into early and middle Illinoian time. The formation is light gray, silty clay with distinctive textural and mineralogical characteristics. It appears to have had a complex origin, including lacustrine and accretion-gley phases. Loess was probably a constituent of local and regional importance. Comparable material from north-central and northeastern Missouri is referred to the Ferrelview, and correlation with accretion-gley deposits on Kansan till in Illinois is inferred.—*from* Authors' abstract

02312 **Howe, Wallace B.** Planar stromatolite and burrowed carbonate mud facies in Cambrian strata of the St. Francois Mountain area: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 41, 113 p., illus., 1968.

One of the distinctive carbonate facies present in Upper Cambrian strata of the St. Francois Mountain area in southeastern Missouri comprises alternating units that are identified as stromatolitic and burrowed carbonate mud types, respectively. This facies is recurrent and is an atypical element in the Bonneterre, Davis, Derby-Doerun, and Potosi Formations. It has a direct but relatively abrupt lateral transition into typical time-equivalent facies, such as the oolitic dolarenites of the Bonneterre. The planar stromatolite and burrowed carbonate mud facies is almost entirely dolostone. This study discusses details of the progressive replacement of the "Taum Sauk" limestone by dolomite.—MST

Howe, Wallace B. *See* Parizek, Eldon J. 02600

07408 **Howie, R. D.; Cumming, L. M.** Possible basement graben beneath Miramichi Bay, New Brunswick [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 283–292, illus., 1967.

The pre-Carboniferous basement beneath this bay appears to have a graben-like trough extending beneath the Gulf of St. Lawrence with a northeast strike for about 70 miles, as judged by offshore aeromagnetic trend lines and by a Bouguer anomaly centred 30 miles offshore and 70 miles east of Bathurst, New Brunswick. A refraction profile from Tracadie to Cheticamp crosses the northwest margin of the structure 10 miles east of Tracadie, where depression of the basement is shown by the lateral change in seismic velocity from 5.9 to 4.6 kmps. An aeromagnetic anomaly indicates that beneath Miramichi Bay the trough-floor is at a depth of -10,000 feet. Analogy with late stage structures on stabilized platforms suggests it is nearly flat, the trough filled to the level of the present New Brunswick shelf, with Carboniferous or younger clastics and evaporites.—*from* Authors' abstract

07362 **Hughes, J. E.** Geology of the Pine Valley, Mount Wabi to Solitude Mountain, northeastern British Columbia: British Columbia Dept. Mines and Petroleum Resources Bull. 52, 137 p., illus., tables, geol. maps, 1967.

Exposed beds form a Triassic to Cretaceous, mostly marine, succession that is 10,000 to 20,000 feet thick, and thickens westward; Cretaceous beds include coal measures. Close folding and thrusting prevailed in the Inner Foothills, while in the Outer, deformation was restricted to anticlinal folding, with faults along the anticlines. Concentric folds of both low and high fold amplitude are recognized. The latter occur in the Inner Foothills, with cuspate and angular folds. The larger tectonic framework, of which this is a part, includes the junction of northern and southern parts of the Rocky Mts., and junctions of three tectonic units of the foreland occupying the site of the Peace River embayment. Parallel fold forms and the Peace River structures are discussed in appendixes. Drill cuttings from two wells are described.—ESL

07324 **Huss, Glenn I.** Field investigation of the Takysie stones 1966 [abs.]: Meteoritics, v. 3, no. 3, p. 113, 1967.

02328 **Husted, Wilfred M.** Archeological sites in loess regions of the Missouri drainage basin—Pt. 1, The probable age of the altithermal on the western plains, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 101–106, illus., 1968.

From archeological evidence and carbon-14 dating of artifacts it appears that the drought effects of the Altithermal period were being felt in northern Wyoming by at least 5500 B.C., but conditions were such that man was able to adapt to the changing environment. By 5000 B.C., however, the situation had become untenable and the area was substantially abandoned. For another 1,000 years the climate became increasingly arid, and then began to return toward more favorable conditions. By 3000 B.C. man was able to return to the area and to continue an occupation that extended into historic times.—MST

Iijima, A. *See* Hay, Richard L. 02253

02217 **Iijima, Azuma; Hay, Richard L.** Analcime composition in tuffs of the Green River Formation of Wyoming: Am. Mineralogist, v. 53, nos. 1–2, p. 184–200, illus., table, 1968.

The Si:Al ratio in analcime samples from the Green River Formation of Wyoming ranges from 1.95 to 2.90; Ca and K are present in only trace amounts. On the basis of silica content, most analcime falls into two groups, one generally having Si:Al ratios between 2.00 and 2.30, and the other ranging from 2.60 to 2.80. High-silica analcime predominates in silicic tuffs. Low-silica analcime is nearly always associated with authigenic alkali feldspars, and is most abundant in the transitional zone between tuffs with siliceous analcime and those lacking analcime and consisting largely of authigenic alkali feldspars. Analcime has extensively reacted to form alkali feldspars in the Green River Formation; new data show that siliceous analcime crystals become partly desilicated in their reaction to form feldspars.—*from* Authors' abstract

07400 **Internat. Union Geol. Sciences.** A comparative table of recently published geological time-scales for the Phanerozoic time—Explanatory notice: Norsk Geol. Tidsskr., v. 47, no. 4, p. 375–380, illus., 1967.

Time scales for Phanerozoic time by A. Holmes (1937, 1959), J. L. Kulp (1960), G. D. Afanes'yev and others (1964), and Geol. Soc. London (W. B. Harland and others, eds., Symposium dedicated to A. Holmes, 1964), are compared and briefly evaluated by the Commission on Geochronology for coordination of radiometric and stratigraphic data in the development of a world time scale. It is noted that the "Holmes Symposium" scale, based on 337 carefully chosen absolute-age dates, is the most detailed ever published; whereas the other scales are practically all concerned only with limits between systems, this scale gives limits of ages for most

stages from the Devonian through Cretaceous. However, it is considered unwise to take these stage limits as being representative of a world scale.—VMJ

Isenberger, K. J. *See* Welp, T. L. 02557

07371 **Itagaki, Kazuhiko.** Particle migration on ice surfaces, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 233–246, illus., 1967.

A novel phenomenon is described which could indicate a new mechanism of mass flow along an ice surface. Glass beads evenly and randomly scattered on an ice surface migrate and tend to form pronounced clusters when the ice surface is exposed to an unsaturated atmosphere. Time lapse motion pictures reveal two types of migration (smooth, continuous and intermittent); both tend to form bead clusters. No movement is observed when the atmosphere is saturated with respect to ice. Conventional mechanisms of surface mass flow such as evaporation–condensation and surface diffusion do not appear to explain the migration. Volume diffusion in ice seems to be too slow a process, and liquid film flow is a rather improbable mechanism. Enhanced diffusivity of the surface layer is one possible mechanism.—*from* Author's abstract

02212 **Ito, Jun.** Synthesis of the berzeliite ($Ca_3NaMg_2As_3O_{12}$)–manganese berzeliite ($Ca_3NaMn_2As_3O_{12}$) series (arsenate garnet): Am. Mineralogist, v. 53, nos. 1–2, p. 316–319, illus., tables, 1968.

Berzeliite and manganese berzeliite were synthesized hydrothermally at 450°–480°C and 1.5 kb. The existence of an immiscibility gap between the end members was not confirmed; above 550°C both minerals decompose. Indexed X-ray powder diffraction data and cell edges are given. Iron, cobalt, copper, nickel, and zinc analogs of berzeliite could not be synthesized under similar conditions; rather, conichalcite, austinite, and the ferrous, cobalt, and nickel analogs of adelite were formed.—JSH

02214 **Ito, Jun.** Synthesis of some lead calcium zinc silicates: Am. Mineralogist, v. 53, nos. 1–2, p. 231–240, illus., tables, 1968.

Lead, calcium, and zinc silicates were crystallized from gels by hydrothermal treatment and heating in air. Phases synthesized are larsenite, barysilite, esperite, margarosanite, alamosite, and three unnamed phases. X-ray powder diffraction data of new phases are recorded; unit cell constants are given where known.—*from* Author's abstract

Izett, Glen A. *See* Wilcox, Ray E. 02223

Jack, R. N. *See* Carmichael, I. S. E. 02511

Jackson, E. V. *See* Potter, R. R. 02410

Jackson, M. L. *See* Borchardt, G. A. 02262

02211 **Jahanbagloo, I. Cyrus; Zoltai, Tibor.** The crystal structure of a hexagonal Al-serpentine: Am. Mineralogist, v. 53, nos. 1–2, p. 14–24, illus., tables, 1968.

A few porcelain-white, platy, hexagonal crystals, measuring up to 2 mm in diameter, were found in the vugs of a Keweenawan rhyolite pebble on the north shore of Lake Superior. The mineral's chemical formula of $Mg_{2.0}Al_{0.6}(Fe,Ca,K)_{0.1}(Si_{1.4}Al_{0.6})O_{4.6}(OH)_{4.4}$ was established by electron microprobe analysis and the hexagonal unit cell dimensions of $a=5.295\pm0.004$ and $c=63.99\pm0.06$A were obtained from single crystal and refined from powder diffraction data. The substructure, as determined from three-dimensional data collected by precession and counter techniques, has a symmetry $P3_1$, and is composed of nine serpentine-like layers per unit cell.—*from* Authors' abstract

02581 **Javandel, Iraj; Witherspoon, Paul A.** Analysis of transient fluid flow in multi-layered systems: California Univ. Water Resources Center Contr. 124, 119 p, illus., tables, 1968.

An analytical solution derived to give the potential distribution in an infinite, two-layered aquifer with a pumped cross flow (assuming the lower layer to be much the thicker and the well open to only a part of the upper layer), has been extended to investigate problems of transient flow in multi-layered systems with cross flow. The procedure, called the finite element method, is based on the minimization of an appropriate variation principle using the direct method of the calculus of variations in conjunction with a discretized continuum. Non-steady state results obtained by the finite element method compared well with results of typical boundary value problems for which analytical solutions are available. For handling complex problems of arbitrary boundary conditions and changes in rock properties, this approach provides a powerful new method.—GDC

07495 **Jehl, Joseph R., Jr.** Pleistocene birds from Fossil Lake, Oregon: Condor, v. 69, no. 1, p. 24–27, illus., tables, 1967.

Two small collections of avian fossils from Fossil Lake, Oregon, are reported. *Melanitta deglandi* and *Erolia melanotos* are reported from these deposits for the first time. A second carpometacarpus of *"Palaeotetrix" gilli* is described, and the genus is placed in the synonymy of *Dendragapus*. *Fulica shufeldti* Brodkorb is treated as a temporal subspecies of *Fulica americana*, as suggested by Howard.—Author's summary

Jenne, E. A. *See* Parker, Garald G. 07396

07430 **Jensen, M. L.** Stable isotopes and the origin of uranium deposits of Utah, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 78–90, illus., 1967.

Examples of the various isotope ratios of sulfur which are a result of bacterial and of magmatic hydrothermal activity are given. Organic matter serves the primary purpose of an energy source for sulfate-reducing bacteria, and the hydrogen sulfide gas which is released by the bacteria is by far the more important reductant that brings about the concentration of sandstone-type uranium deposits. Whether the reduction occurred diagenetically or during the Laramide is unclear, although the thick sedimentary layer would have produced heat which would have made bacterial life improbable. The causes of pyritization, silicification, sericitization, and kaolinization have been suggested from the stable isotope studies, none of which need require magmatic origin.—HRC

07325 **Johari, O.; Knox, R., Jr.** Thin film studies of the substructure of metallic meteorites by electron microscopy [abs.]: Meteoritics, v. 3, no. 3, p. 114, 1967.

02194 **Johnson, J. G.; Boucot, A. J.; Gronberg, E. C.** A new genus of stringocephaloid brachiopod from the Middle Devonian of Nevada: Jour. Paleontology, v. 42, no. 2, p. 406–414, illus., 1968.

Conomimus truncatus is described as a new genus and species of stringocephaloid brachiopod of Middle Devonian, Givetian age from central Nevada. It lacks median septa in either valve and lacks crural plates in the brachial valve but possesses a short, spatulate cardinal process. *Conomimus* appears to be most closely related to *Geranocephalus*, from which it differs principally by the absence of crural plates. Mapping of the collection site in the Telegraph Canyon Formation of the upper part of the Nevada Group at Table Mountain, Mahogany Hills, central Nevada, shows that *Conomimus truncatus* is abundant in a stratigraphic position above *Stringocephalus* and well above beds of Eifelian and Emsian age in a simple homoclinal sequence of Lower and Middle Devonian rocks.—Authors' abstract

02292 **Johnson, Rockne H.; Norris, Roger A.** Geographic variation of Sofar speed and axis depth in the Pacific Ocean: Jour. Geophys. Research, v. 73, no. 14, p. 4695–4700, illus., 1968.

Contour charts of Sofar speed and axis depth are presented for the Pacific Ocean extending from 60° N. to 60° S. Meridional section of sound speed is included. Speeds were computed from hydrographic data by Wilson's formula. An example of an application of the charts is the location by T phase of earthquakes along the East Pacific rise and the Pacific Antarctic ridge, events readily detected on hydrophones in the North Pacific.—KAS

07379 **Jones, W. Barclay; Carpenter, Robert A.** X-ray-fluorescent analysis of multiple component samples by a nondispersive system, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 465-482, illus., table, 1967.

The system uses a radioactive source to excite the characteristic X-rays of the sample, and a lithium-drifted semiconductor detector to detect these X-rays. This method of analysis is made possible by recent advances in solid state detection resolution and electronic circuitry, which have led to the superior energy discrimination needed to resolve X-rays of elements. Tests have shown that less than 100 parts per million of several elements can be simultaneously identified. Accuracy of measurements is discussed in terms of sensitivity and time needed for the measurements. Matrix effects are discussed.—*from* Authors' abstract

07491 **Jordan, Louise; Roberts, John F.** (compilers). Subsurface mapping, 1964-1966, Map VII—Index to geologic mapping in Oklahoma, Supp. 2: Norman, Okla., Oklahoma Geol. Survey, scale about 1 in. to 16 mi., 1967.

02529 **Jordan, Robert R.** Observations on the distribution of sands within the Potomac Formation of northern Delaware: Southeastern Geology, v. 9, no. 2, p. 77-85, illus., 1968.

The Potomac Formation is a continental unit of Cretaceous age that is widespread in the northern Atlantic Coastal Plain. In northern Delaware the sands within the Potomac are important aquifers and their correlation has received much attention but has proven to be very difficult. An experimental approach is presented here in which well logs of the Potomac are correlated using basement as a datum plane and the proportion of wells containing sand (as opposed to clay) at intervals above the basement is calculated. This is thought to provide an indication of the variations in sand and clay content of the sediment supplied to the basins during Potomac time. The resulting graph of the proportion of wells containing sand plotted against distance above basement appears to be compatible with what is known of the geology and hydrology of the Potomac Formation in Delaware.—Author's abstract

02437 **Kachadoorian, Reuben.** Effects of the earthquake of March 27, 1964, on the Alaska highway system: U.S. Geol. Survey Prof. Paper 545-C, p. C1-C66, illus., tables, 1968.

The Alaska earthquake of March 27, 1964, severely crippled the highway system in the south-central part of the State. Damage totaled more than 46,000,000 dollars—over 25,000,000 dollars to bridges and nearly 21,000,000 dollars to roadways—and was caused chiefly by seismic shaking, compaction of fills and underlying sediments, lateral displacement of roadways and bridges, fractures, landslides, seismic sea waves, and regional tectonic subsidence. Damage intensity was controlled primarily by the geologic environment and secondarily by engineering characteristics of the structure. Geologic factors include type of foundation material, type and thickness of sediments, and depth to water table. Engineering characteristics include thickness of fills, type of bents and piers, and weight ratio and the tie between bridge substructure and superstructure.—RK

Kamprath, E. J. *See* Rice, H. B. 02266

Kanamori, Hiroo. *See* Fujisawa, Hideyuki. 02331

Karr, Clarence, Jr. *See* Estep, Patricia A. 02230

02601 **Karr, Clarence, Jr.; Schultz, Harry D.** Wide-line nuclear magnetic resonance spectroscopy of sulfur-33 in minerals: Spectroscopy Letters, v. 1, no. 5, p. 205–210, table, 1968.

Nuclear magnetic resonance spectra of S-33 in solid samples were obtained for the first time. Although the natural abundance of S-33 is quite low (0.74 percent), good signals were obtained for sphalerite (ZnS) and pyrrhotite ($Fe_{1-x}S$). In addition, separate signals were obtained for the first time for a binary mixture of sulfur compounds (sulfur dissolved in liquid CS_2).—Authors' abstract

02403 **Karrow, P. F.; White, O. L.** Pleistocene geology of the Bolton area, southern Ontario: Ontario Dept. Mines Prelim. Geol. Map P. 477, scale 1:50,000, text, 1968.

Bedrock in the Bolton area crops out along valleys and in the Niagara escarpment region; its surface shows considerable relief. Glacial debris has been deposited over a long period and as a result of ice advance from the northeast and southeast. Two tills are recognized in the north and five (three found at the surface) in the south. Present major streams occupy valleys that predate the last ice advance and there is a close relation between present valleys and preglacial drainage valleys, resulting in exposure of useful supplies of sand and gravel. Ground water is usually obtained from the glacial deposits. Other resources of value are building stone, clay products, and limestone.—MCM

Kasper, Andrew. *See* Andrews, Henry. 02346

02234 **Katz, Amitai.** The direct and rapid determination of alumina and silica in silicate rocks and minerals by atomic absorption spectroscopy: Am. Mineralogist, v. 53, nos. 1–2, p. 283–289, tables, 1968.

Atomic absorption spectroscopy is a rapid and convenient method for the determination of silica and alumina in silicate rocks. NaOH fusion of the samples in nickel crucibles is more complete and superior to Na_2CO_3 fusion in platinum. Non-resonance light absorption within the flame has been eliminated by: a) reduction of the solution feed-rate to about 75 percent of that yielding maximum absorption; b) application of the nitrous oxide-acetylene burner.—Author's abstract

Kaufman, Robert I. *See* Kolb, Charles R. 07389

02432 **Keech, C. F.** Water levels in observation wells in Nebraska, 1967: Nebraska Water Survey Paper 23, 60 p., illus., tables, 1968.

Water levels in many observation wells in Nebraska have been measured for more than 20 years, and some since 1934; however, new wells are continually being added and some are inadvertently destroyed. Currently the program includes 1,198 wells, and for 531 of these the water-level measurements made in 1967 are given in this report. Except for a few, measurements were made in the fall after the close of the irrigation season. Average water levels in wells were lower than the 1966 fall readings in 49 of the 93 counties. Declines occurred in all counties in the Blue River basin except in Butler County, and generally in the panhandle area as a result of dry weather conditions. Levels rose in the lower Platte River valley and in Gosper, Phelps, and Kearney Counties.—MCM

02597 **Keech, C. F.; Dreeszen, V. H.** Availability of ground water in Adams County, Nebraska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-287, scale 1:125,000, text, 1968.

Adams County is underlain by Pleistocene unconsolidated and Pliocene semiconsolidated deposits with a combined thickness of 100–500 feet; underlying them is a thick sequence of consolidated rocks of Cretaceous and other ages, considered here as bedrock. Most ground water is within the Pliocene and Pleistocene deposits; estimated coefficients of transmissibility in gpd per ft range from less than 500 gpm to more than 200,000 gpm. Water in unconsolidated deposits is excellent for most purposes; that in deeper formations is highly mineralized. Maps show configuration of base of Pleistocene deposits and distribution of pre-

Pleistocene rocks, depth to water and water-table configuration, and locations of test holes and irrigation wells and availability of ground water.—MCM

Keil, Klaus. *See* Short, James M. 07439

02589 **Keim, Paul F.** Engineering geologic studies for sewer projects—Discussion [of paper 5780 by D. M. Greer and D. C. Moorhouse, 1968]: Am. Soc. Civil Engineers Proc., v. 94, paper 6049, Jour. Sanitary Eng. Div., no. SA4, p. 760–761, 1968.

General experience and knowledge of the area have a large place in the decision about the point beyond which the cost of further studies would not be justified. The writer believes the authors (ibid., v. 94, paper 5780, Jour. Sanitary Eng. Div., no. SA1, p. 21–30, 1968) have suggested some very good points for garnering general knowledge, but believes there is an open question as to whether some can be obtained in advance economically. He believes they state the case clearly as to the engineer's responsibility, discusses briefly the sufficiency of data placed on reports and drawings, and adds that each project is an individual undertaking and thus he cannot understand the use of the term 'standard.'—ESL

07410 **Kelley, Danford G.** Some aspects of Carboniferous stratigraphy and depositional history in the Atlantic Provinces [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 213–228, illus., tables, 1967.

Since diachronous Carboniferous contacts were found in eastern Canada, removal of time-restriction and other modifications permit use of the Horton and Windsor "groups" as rock-stratigraphic terms, and some modification in the Upper Carboniferous units: Canso, Riverdale, Cumberland and Pictou "groups". In an updated regional synthesis of Carboniferous history, depositional troughs and sub-basins were separated and fed by fault-bounded uplands within a broad subsiding Fundy basin. Tectonic activity was not synchronous, so within a few miles unconformable contacts are adjacent to one upland and where sedimentation was uninterrupted, conformable contacts are adjacent to another. The most complete Carboniferous section is preserved from southeastern New Brunswick and northern Nova Scotia to southern Newfoundland, the most active central area in the Fundy basin.—GDC

Kennedy, M. J. *See* Neale, E. R. W. 07457

02595 **Ketner, K. B.; Evans, J. G.; Hessin, T. D.** Geochemical anomalies in the Swales Mountain area, Elko County, Nevada: U.S. Geol. Survey Circ. 588, 13 p., illus., 1968.

The Swales Mountain area, Elko County, Nev., contains a window in the upper plate of the Roberts Mountains thrust. Upper plate rocks, which consist of bedded chert and shale of Ordovician age, are assigned to the Vinini Formation. Lower plate rocks are carbonaceous silty limestone, probably the Roberts Mountains Formation of Silurian age, and an unnamed limestone unit of Devonian to earliest Mississippian age. Upper and lower plate rocks are intruded by Tertiary monzonite porphyry and quartz porphyry stocks and dikes. Contact zones around the igneous rocks contain some gold, silver, molybdenum, copper, lead, and zinc; but the areas of anomalous metal occurrence are small, and only weakly anomalous zones were found in three drill holes.—Authors' abstract

07326 **King, Elbert A., Jr.** Composition of Georgia tektites [abs.]: Meteoritics, v. 3, no. 3, p. 114, 1967.

07415 **King, Lewis H.** On the sediments and stratigraphy of the Scotian Shelf [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 71–92, illus., 1967.

Shelf sediments south of Halifax, Nova Scotia, have five facies, representing a relict glacial-marine environment. Pleistocene glacial debris covering the shelf was reworked and redeposited in littoral and sublittoral zones of a low sea-level stand, as indicated by a submarine terrace at 110 to 115 m depth. Wave action of the

Holocene Sea on high bank areas has produced transgressive basal sand and gravel facies, winnowing out fines for redeposition as the glacial-marine sand, silt, and overlapping clay facies; unmodified debris is designated glacial till. Delineated by echograms, seismic reflection profiles, radiogenic ages, and preliminary geologic maps, Pleistocene and younger sediments rest unconformably across truncated bedrock strata, possibly Tertiary or Cretaceous, in a glacially eroded, dissected coastal plain.—GDC

Kirby, John R. *See* Zietz, Isidore. 02366

Kirby, John R. *See* Zietz, Isidore. 02367

Kirby, John R. *See* Zietz, Isidore. 02368

Kirby, John R. *See* Zietz, Isidore. 02369

07327 **Kirsten, T.; Schaeffer, O. A.** Rare gases in the St. Severin meteorite [abs.]: Meteoritics, v. 3, no. 3, p. 115, 1967.

07463 **Kleinpell, R. M.; Weaver, D. W.; Doerner, D. P.** Glimpses of the Paleogene depositional records west, north, northeast, and east of the Gabilan Mesa, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 38–44, illus., table, 1967.

The depositional record and faunal sequences in the northern Santa Lucia Mts., Santa Cruz Mts., Bolado Park Formation, and New Idria area, Calif., show two major features of Tertiary history. Widespread marine conditions existed almost to the Oligocene, but a large part of the deposits was stripped off before Miocene transgression, due to three orogenies. A correlation chart accompanies the paper. Faunas described are principally Foraminifera and nannoplankton with some mollusks.—ESL

02337 **Klement, William, Jr.** High-low quartz inversion—Scaling laws—Approximate relations for volume and compressibility versus temperature at high pressures: Jour. Geophys. Research, v. 73, no. 14, p. 4711–4716, illus., 1968.

Very near the high-low quartz inversion, the variation of certain thermodynamic parameters may be identified with the predictions from the solved Ising models. For low quartz, at least about 10° below the inversion, a "classical" model accounts for many of the data over extensive ranges of temperature. A method is outlined for estimating the volume and compressibility versus temperature for low quartz slightly below the inversion and up to about 10 kb with only modest approximations.—Author's abstract

Kleppa, O. J. *See* Holm, J. L. 02200

Knox, R., Jr. *See* Johari, O. 07325

07389 **Kolb, Charles R.; Kaufman, Robert I.** Prodelta clays of southeast Louisiana, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 3–21, illus., 1967.

The prodelta clays of southeastern Louisiana can be subdivided into four units, each one correlative with present or past deltas of the Mississippi River. Visual examination of cores of these deposits reveals almost no discernible structure. However, radiographs show that flowage, distortion of layering, and fracturing are present on a large scale. Such distortion is more pronounced in the uppermost portions of each of the prodelta units where addition of sedimentary load was rapid, than at the bottom of a given unit where deposition was comparatively slow. There are indications that fracturing and extensive slickensiding of the clays were the result of the sudden influx of deposits associated with the present delta.—*from* Authors' abstract

Kolipinski, Milton C. *See* Schneider, William J. 02375

02433 **Korkman, K.** Aftershock P-wave spectra and dynamic features of the Aleutian Islands earthquake sequence of February 4, 1965: Tectonophysics, v. 5, no. 3, p. 245–266, illus., tables, 1968.

The aftershock sequence starting February 4, 1965, in the Aleutian Islands region is studied with regard to its development in time and space. Energy release characteristics are evaluated and the possibility of a regular oscillation of seismic activity between the two extremes of the region is examined. No such oscillation is found to take place. Short-period P-wave spectra of the aftershocks are studied in relation to epicentral positions and characteristics of the aftershock process. The variation in spectral shape is considerable. Indications are found of the influence of aftershock location on spectra. The spectral effects of regional stress relaxation appear to be less than those of other causes.—Author's abstract

Koyanagi, R. Y. *See* Fiske, R. S. 02427

Koyumdjisky, H. A. *See* Yaalon, D. H. 02220

02296 **Kraut, Edgar A.** Diffraction of elastic waves by a rigid 90° wedge, Pt. 1: Seismol. Soc. America Bull., v. 58, no. 3, p. 1083–1096, illus., 1968.

The problem of calculating the reflected and diffracted elastic waves generated when a plane compressional wave strikes a rigid quarter plane is formulated as a Wiener-Hopf problem in two complex variables. It is shown how a closed form solution of this two variable Wiener-Hopf problem can be obtained provided that the Laplace transform of the elastic wave Green's function can be factorized into factors having suitable analytic properties.—Author's abstract

02297 **Kraut, Edgar A.** Diffraction of elastic waves by a rigid 90° wedge, Pt. 2: Seismol. Soc. America Bull., v. 58, no. 3, p. 1097–1115, illus., 1968.

Integrals representing the reflected and diffracted elastic waves generated by the incidence of a plane compressional wave on a rigid quarter-plane are evaluated by an application of the Cagniard-De Hoop technique. It is shown that diffracted spherical waves radiate away from the tip of the quarter-plane at the shear and compressional wave speeds. The spherically spreading compressional wave excites secondary shear waves on the surfaces and edges of the quarter-plane. These secondary spherical wavelets envelope a ruled surface which is conical in shape at the edges of the scatterer. The envelope propagates away from the quarter-plane at the critical angle and forms a Mach wave or bow wave. The usual reflected shear and compressional plane waves are also present and combine with the diffracted waves to form the geometric shadow of the quarter-plane.—Author's abstract

02358 **Kruger, S. T.; Heymann, Dieter.** Cosmic-ray-produced hydrogen 3 and helium 3 in stony meteorites: Jour. Geophys. Research, v. 73, no. 14, p. 4784–4787, illus., table, 1968.

It is shown that it is possible to estimate the production ratio ϵ in oxygen, the most abundant element in stony meteorites, by plotting H-3/He-3 versus the ratio of neutron to proton in the elements. A table gives ϵ and adjusted He-3 production rates for various classes of stony meteorites.—DBV

Kryder, R. W. *See* Eggert, D. A. 02303

Kullerud, Gunnar. *See* Craig, James R. 02218

02596 **Kunz, George Frederick.** Gems and precious stones of North America (reprint of 2d edition, 1892): New York, Dover Publications, 367 p., illus., tables, 1968; originally published 1890.

A popular description of gem stones, their occurrence, value, history, archaeology, and of the collections in which they exist, is presented in 16 chapters which include

one on pearls. Remarkable foreign gems owned in the United States are also described. A new introduction (which includes a biography of Kunz) by Edward Olsen and the list of plates were especially prepared for this Dover edition, which is an unabridged and corrected republication of the second edition, published in 1892.—GDC

Kuroda, P. K. *See* Arino, H. 02579

07399 **Lacey, J. E.; Carozzi, A. V.** Critères de distinction entre oolithes autochtones et allochtones—Application au calcaire de Sainte-Geneviève (Viséen) de l'Illinois, U.S.A. [with English abs.]: Centre Recherches Pau Bull., v. 1, no. 2, p. 279–313, illus., table, 1967.

Studies of oolitic sands of Great Salt Lake, Utah, show that sorting action during transportation produces a direct relation between size of oolites and size of uncoated grains, parameters independent of each other when transportation does not occur. This relation is demonstrated in consolidated rocks, the Ste. Genevieve Limestone, through a size distribution study of closely spaced thin sections and calculation of size parameters by a computer program using data from more than 300,000 grains. By combining petrographic features with logarithmic phi skewness, autochthonous were distinguished from three types of allochthonous oolites. The Ste. Genevieve revealed zones of autochthonous oolites surrounded by proximal zones of allochthonous oolites of type 1 followed by distal zones of type 2 and 3 according to a pattern of radially decreasing energy.—ESL

02544 **LaChapelle, E.** Stress-generated ice crystals in a nearly isothermal two-phase system [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 183–198, illus., 1968.

A water-filled cavity intersected by a tunnel in nearly stagnant ice of the Blue Glacier, Washington State, U.S.A., was lined with large and unusual single ice crystals which apparently owe their origin to the effects of hydrostatic stress. Even the minute differences in pressure melting point around this cavity are adequate to remove the heat of fusion as ice forms within it. There is evidence that interstitial movement of melt water in the surrounding ice also contributes to the heat and mass transfer. The form of these crystals indicates that they grew into slightly supercooled water. It is suggested that this growth pattern is sustained by the existence of oriented stresses at the cavity walls.—*from* Author's abstract

Laine, L. L. *See* Dover, T. B. 02590

Lamar, D. L. *See* Merifield, P. . 02363

07487 **Landyreva, N. S.** Sil'nyye zemletryaseniya mira v 1964 g. [Strong earthquakes of the world in 1964], *in* Zemletryaseniya v SSSR v 1964 godu: Moscow, Akad. Nauk SSSR, p. 185–191, illus., table, 1967.

World earthquakes with $M \geq 6$ that occurred in 1964 are catalogued, giving date, origin time, epicentral coordinates, depth (where known), magnitude, and region. A map shows the distribution of their epicenters. The amount of seismic energy released in 1964 was 445.7×10^{22} ergs, three times as much as in 1963. As in 1963, the greater part (93 percent) of the activity was along the Pacific Ocean seismic belt; in that belt the most active region was Alaska, where an earthquake of $M = 8.5$ occurred on March 28 at 3^h36^m. The Alaska earthquake is discussed briefly; with its aftershocks, it accounted for 55.8 percent of the total earthquake energy in the world in 1964. Other notable shocks in 1964 are mentioned briefly.—DBV

Langway, Chester C. *See* Wright, Frances W. 07449

02249 **Laughbaum, Graydon H., Jr.** Oil fields of Cook Inlet, Alaska [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 55 [1968].

Leahy, E. J. *See* George, P. T. 02404

07344 **Ledezma Guerrero, Odilon.** Carta geológica de México—Hoja Parras 13 R-1(6): México, D.F., México Univ. Nac. Autónoma Inst. Geología, scale 1:100,000, sections, text, 1967.

The Parras area in Coahuila and Zacatecas forms part of the Sierra Madre Oriental and lies also in the physiographic province of Sierras Transversales. Formations ranging from the Triassic Nazas Formation to Quaternary alluvium are described in detail. The principal structures, a series of anticlines and synclines, are delineated. The Salitrillo fault has been considered to be a southeastern extension of the San Francisco fault. Three tectonic zones are recognized: Valles y Cumbres, Llanos y Serras, and igneous intrusives. Resources of economic interest are copper, lead, asbestos, and phosphate.—MCM

Lee, Fitzhugh T. *See* Robinson, Charles S. 07486

Lee, G. B. *See* Petersen, G. W. 02288

Leisman, G. A. *See* Schlanker, C. M. 02351

Leonard, A. R. *See* Dover, T. B. 02590

Leonard, R. A. *See* Weed, S. B. 02270

02527 **Levinson, Stuart A.** *Eoaquapulex*, new name for *Diplopsis* Levinson, 1961: Micropaleontology, v. 14, no. 2, p. 248, 1968.

The fact has been brought to the author's attention that *Diplopsis* Levinson, 1961 is a junior homonym of *Diplopsis* Fauvel, 1902, a genus of Coleoptera. He therefore proposes the new generic name *Eoaquapulex* to replace *Diplopsis* Levinson, 1961. [See ibid., v. 7, no. 3, p. 361, 1961.]—MST

07364 **Lewis, C. F. M.; McNeely, R. N.** Survey of Lake Ontario bottom deposits, *in* Conf. on Great Lakes Research, 10th, Toronto, Ontario, 1967, Proc.: Ann Arbor, Mich., Internat. Assoc. Great Lakes Research, p. 133–142, illus., 1967.

Short gravity cores and grab samples, recovered during a continuing reconnaissance survey initiated in 1966, were used to study the distribution, stratigraphy, and chronology of Lake Ontario bottom deposits. Three major groups of surficial deposits were recognized: complex nearshore sediments, glaciolacustrine clays, and postglacial muds. Organic contents of 2 to 6 percent and median particle diameters of 1 to 4 microns are typical of the offshore surficial muds. Pollen in these sediments facilitates correlation and subdivision and indicates that the present sedimentation rate in the main basin is approximately 10 cm per century. Several sediment sequences confirm the postglacial low-level Admiralty Lake stage and suggest it may have reached lower levels than previously believed.—Authors' abstract

02489 **Lewis, James G.** Instruments for plotting from color aerial photographs, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 472–479, illus., 1968.

By 1963, 45 percent of the airphotos taken by the U.S. Coast and Geodetic Survey for reproduction of nautical charts were in color. Since 1965, the U.S. Geological Survey has from time to time used color airphotos experimentally in stereoscopic plotting instruments as new developments in color progressed. Most of such instruments in current use can be used to plot directly from color airphotos without alteration; some require modification before color can be used. The several color compatible stereoscopic plotters which are presently available are illustrated.—GDC

Lewis, Richard Q., Sr. *See* Taylor, Alfred R. 02414

Li, Yuan Hui. *See* Takahashi, Taro. 02536

07422 **Lifshin, Arthur.** Migration of elements across an igneous contact (preliminary results): Compass, v. 45, no. 1, p. 40–44, illus., 1967.

One of the major problems of metasomatism is the movement of elements across the contact with intruded country rock. The chemical association of these elements and the parameters which define and control their migration have been studied petrographically in samples of small granitic dikes intruded into schists in southwestern Connecticut; continuous sampling was carried out along traverses starting in the dike and finishing in schist. Analysis was by emission spectrograph using the interrupted arc technique. Twelve graphic representations of distances from the contact for various elements are given. Some show a preferential concentration at a position close to the contact. The semipermeable nature of the contact is indicated by the small amount of material that does cross.—ESL

07409 **Lilly, Hugh D.; Brueckner, W. D.** (editors). Some notes on stratigraphy and structural style in central west Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 201–211, illus., 1967.

Cambrian–Ordovician strata, east to west, belong to three major units: the metasedimentary Grand Lake Brook Group; a carbonate sequence including basal Labrador Group, eastward-thickening wedges of the Reluctant Head Formation and St. George Group, and westward thickening Table Head Group; and the clastic Humber Arm Group including top layers of basic volcanics. The metamorphic rocks can be traced laterally into fossiliferous Lower Cambrian strata of the Labrador Group, but generally are detached from Middle Cambrian to Middle Ordovician rocks. The recently proposed Humber Arm Group, overlying the carbonates, may be a klippe thrust westward. The metamorphic core has west-facing recumbent isoclinal folds, cut by steep southeast-dipping cleavage. In the tightly folded carbonate sequence structural dips are eastward; structures in the Humber Arm Group dip westward.—GDC

02219 **Lin, H. C.; Foster, W. R.** Studies in the system BaO–Al_2O_3–SiO_2—[Pt.] 1, The polymorphism of celsian: Am. Mineralogist, v. 53, nos. 1–2, p. 134–144, illus., tables, 1968.

Prolonged anhydrous and hydrothermal heating experiments made with natural and synthetic materials have confirmed the following polymorphic relations: Monoclinic celsian is stable from room temperature up to 1590°C, where it inverts sluggishly and reversibly to hexagonal hexacelsian. The latter, stable to the melting point at about 1760°C, readily persists metastably on cooling below 1590°C, and inverts rapidly and reversibly to an orthorhombic form on cooling through 300°C. Paracelsian appears to be a metastable phase, and changes monotropically through hexacelsian to celsian at temperatures at least as low as 500° and possibly at lower temperatures also.—Authors' abstract

02450 **Lindsley, D. H.; Speidel, D. H.; Nafziger, R. H.** P–T–oxygen fugacity relations for the system Fe–O–SiO_2: Am. Jour. Sci., v. 266, no. 5, p. 342–360, illus., table, 1968.

Intensive-variable phase diagrams are receiving more frequent use by petrologists. Phase relations for the system Fe–O–SiO_2 expressed in P–T–oxygen fugacity (intensive-variable) space provide a necessary building block for more complex but geologically important systems and also illustrate several important principles in the construction of such diagrams. The important phase relations for this system can be derived by application of Schreinemakers' rules to published experimental data obtained at 1 atm and a relatively few data obtained at high pressures. Two invariant assemblages, each of five condensed phases, occur in the system: fayalite–silica–ferrosilite–iron–liquid at 17.5 kb, 1280°C, and $10^{-10.85}$ atm oxygen fugacity; and fayalite–silica–ferrosilite–magnetite–liquid at 17 kb, 1205°C, and $10^{-7.25}$ atm oxygen fugacity.—Authors' abstract

02532 **Lineback, Jerry A.** Turbidites and other sandstone bodies in the Borden Siltstone (Mississippian) in Illinois: Illinois Geol. Survey Circ. 425, 29 p., illus., 1968.

Deep-water turbidites and shallow-water sandstone bodies are found in the Borden Siltstone deltaic sequence of Valmeyeran age (Middle Mississippian) in central and east-central Illinois. The turbidites are composed of very fine-grained, well-sorted,

mineralogically mature, and graded quartz sand. Such bodies were formed when sand was carried by a river into a delta environment that was normally characterized by siltstone and silty shale deposition. Sand accumulated on the foreset slope of the delta off the mouths of major distributaries; it moved downslope, giving rise to turbidity currents that carried it across a gently sloping pro-delta plain. Shallow-water sandstone bodies are present in the topset part of the delta sequence, but are not turbidites and exhibit shallow-water bedding features.—*from* Author's abstract

02192 **Lipps, Jere H.; Sylvester, Arthur G.** The enigmatic Cambrian fossil *Volborthella* and its occurrence in California: Jour. Paleontology, v. 42, no. 2, p. 329–335, illus., 1968.

Volborthella Schmidt is a minute, tubular, agglutinated, and conical fossil that is composed either of oriented heavy mineral grains or quartz and other mineral grains. It is found abundantly in Lower Cambrian strata in northern Europe and is reported for the first time from western North America. The fossil has been referred to the Cephalopoda, Pteropoda, Tunicata, Protozoa, or to an unknown group of organisms. In its selectivity and orientation of the mineral grains, tubular form, and absence of shelly material, *Volborthella* is similar to certain agglutinated Foraminifera or polychaete worm tubes but certainly not to mollusks or tunicates. *Volborthella* is not assigned to a particular group but is regarded as possibly a small polychaete tube or a wormlike animal of unknown affinities.—Authors' abstract

02202 **Lipps, Jere H.; Valentine, James W.; Mitchell, Edward.** Pleistocene paleoecology and biostratigraphy, Santa Barbara Island, California: Jour. Paleontology, v. 42, no. 2, p. 291–307, illus., tables, 1968.

Pleistocene fossils were found on two marine terraces having shoreline angle elevations of 130 feet and 25 to 30 feet on Santa Barbara Island, California. They include 22 species of foraminifera, 92 of mollusks, 3 of ostracodes, a stony coral, and 2 vertebrates from the lower terrace, and 30 species of foraminifera, 19 of mollusks, and 14 of ostracodes from the higher terrace. Both assemblages were deposited along open coasts, on gravelly substrates and probably in depths of between 10 and 20 feet. The upper terrace association resembles those described from terrace localities that lie above 100 feet on other California Channel Islands. An age close to Yarmouthian or Aftonian is suggested for the higher island terraces, and one of Sangamonian for the lower terraces.—*from* Authors' abstract

07464 **Lipps, Jere H.** Miocene calcareous plankton, Reliz Canyon, California, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 54–60, illus., table, 1967.

Reliz Canyon, west of King City, Monterey County, is the type locality for zones in the Saucesian, Relizian, and Luisian Stages in the Monterey Formation. A correlation chart shows the relation of the Reliz Canyon section to the faunal zones and European stages. Benthonic species of Foraminifera, supported by nannoplankton, provide bases for subdividing the section into 18 zones. The stratigraphic distribution of planktonic Foraminifera and calcareous nannoplankton in the mid-Cenozoic of California is tabulated, and selected species are illustrated.—ESL

07503 **Lissey, A.** Aquifer exploration and development, Chap. 9 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 195–219, illus., 1967.

A five-step plan of exploration is proposed for the engineer to: define the area, find the aquifers, describe them geologically and hydrologically, and choose the best. Commonly used techniques, briefly described, include surface geophysics, subsurface drilling, and permeability determination. The development procedure suggested comprises three steps: choosing how the aquifer is to be exploited; choosing the facilities needed; constructing the extraction, transmission, recharge and treatment facilities as required. Of these the most important aspect is well construction.—GDC

02435 **Lohman, Kenneth E.; Andrews, George W.** Late Eocene nonmarine diatoms from the Beaver Divide area, Fremont County, Wyoming: U.S. Geol. Survey Prof. Paper 593-E, p. E1-E26, illus., table, 1968.

The Beaver Divide Conglomerate Member of the White River Formation, as exposed on the Beaver Divide in Fremont County, Wyo., contains large blocks of silicified fresh-water limestone derived from the Wagon Bed Formation of late Eocene age. These limestone blocks contain the earliest known nonmarine diatoms from North America. The diatom assemblage of the Wagon Bed Formation is well preserved and consists of a new diatom genus, 27 new species, 2 species previously reported from the Miocene, and 5 species still found in living assemblages. It lacks many of the genera common to fresh-water assemblages of later Tertiary age. The few still-living species suggest that deposition was in a temperate circumneutral lake.—KEL

07480 **Louisiana State University.** (Coastal Studies Institute). Investigations of bed-load particle transport velocities—Cooperative program in Uppsala: Louisiana State Univ. Coastal Studies Bull. 1 (Tech. Rept. 38), p. 19-21, 1967.

In fluvial and coastal environments, the process of sorting during bed-load transport due to variable flow rates is of great importance to sediment composition and morphology control. Therefore, a series of experimental investigations was initiated at the Geomorphology Laboratory of the Dept. of Physical Geography, Uppsala Univ., Sweden. The program included studies of single particle transport velocities under variable bed roughness, and mass transport rates of individual fractions of sediments. Preliminary results are described.—ESL

Luft, Stanley J. *See* Taylor, Alfred R. 02414

02330 **Lugn, A. L.** The origin of loesses and their relation to the Great Plains in North America, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 139-182, illus., table, 1968.

There is little doubt that eastern Colorado and other areas of the western High Plains were important sources of loessic materials and ancient and modern dust storms, particularly since mid-Pleistocene times during the stripping of the Tertiary cover. In these areas, as in the more easterly area of the Nebraska Sand Hills, where stripping of Ogallala beds may still be less than 50 percent complete, normal fluvial erosion and slope-wash also have been important and necessary for facilitating wind erosion and transportation of eolian silt and loessic materials out of the area by wind.—MST

02402 **Mackasey, W. O.** Sandra township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 480, scale 1 in. to 1/4 mi., text, 1968.

The text for Sandra township is abstracted with Map P. 479 (Dorothea township), by Mackasey, 1968.—MCM

02415 **Mackasey, W. O.** Dorothea township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 479, scale 1 in. to 1/4 mi., text, 1968.

The area of Dorothea, Sandra, and Irwin townships is underlain by Keewatin-type mafic and felsic metavolcanic and Timiskaming-type metasediments, all cut by numerous dikes and lenticular bodies of diorite; it is transected by a gently westward-dipping intrusive diabase sheet. Pleistocene sand and gravel deposits attain a thickness of more than 100 feet at one location. The outcrop pattern outlines an east-striking fold system; prominent easterly-striking linears are mainly faults. Resources of economic interest are gold, silver, molybdenum, copper, lead, zinc, palladium, iron, asbestos, and sand and gravel.—MCM

02426 **Mackasey, W. O.** Irwin township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 481, scale 1 in. to 1/4 mi., text, 1968.

The text for Irwin township is abstracted with Map P. 479 (Dorothea township), Mackasey, 1968.—MCM

02504 **Mackay, J. Ross.** Discussion of the theory of pingo formation by water expulsion in a region affected by subsidence [by R. C. Bostrom, 1967]: Jour. Glaciology, v. 7, no. 50, p. 346–350, illus., 1968.

From a discussion of the theory of pingo formation proposed by Bostrom (ibid., v. 6, no. 46, p. 568–572, 1967) it is concluded that the closed-system theory of pingo formation (Porsild, 1938; Müller, 1959; Shumskiy, 1959) is the most acceptable for the group A pingos (Mackenzie River delta type) although some modification is desirable. Ice lensing is relatively more important for group B pingos.—VSN

MacLeod, Norman S. *See* Snavely, Parke D., Jr. 02446

02210 **Mahan, Sheila N.; Rogers, John J. W.** A study of grain contacts in some high-grade metamorphic rocks: Am. Mineralogist, v. 53, nos. 1–2, p. 323–327, tables, 1968.

Grain contacts between minerals in high-grade metamorphic rocks have been studied using the ratio: percentage of contact length of mineral *A* in contact with mineral *B* to modal percentage of mineral *B*. A ratio of 1 would indicate that mineral *B* was in contact with mineral *A* in direct proportion to the percentage of *B* in the rocks. All minerals except biotite have a contact ratio near unity. The ratio of potassium feldspar in metamorphic rocks (0.83) is quite different from its ratio of 0.45 in granites. The relatively high ratio in metamorphic rocks is presumed to be indicative of crystallization of potassium feldspar in a comparatively solid medium.—BAM

02438 **Mamay, Sergius H.** *Russellites*, new genus, a problematical plant from the Lower Permian of Texas: U.S. Geol. Survey Prof. Paper 593–I, p. 11–115, illus., 1968.

Fossil plants from the Lower Permian Belle Plains Formation, Baylor County, Texas, are described as the new genus *Russellites*, with the type species *R. taeniata* (Darrah) Mamay, new combination. Previously, identical material from the same locality had been assigned incorrectly by Darrah to the Asiatic genus *Tingia* Halle. *Russellites* has cycadlike, pinnate fronds with large, parallel-veined pinnae characterized by clasping bases and truncated apices; possibly it is a member of the order Noeggerathiales. *Russellites* promises to be a valuable guide fossil and possibly a facies indicator.—SHM

Mao, Ho-Kwang. *See* Takahashi, Taro. 02352

Marangunic, Cedomir. *See* Bull, Colin. 07477

Maringer, R. E. *See* McCall, J. L. 07330

Marshall, Neil F. *See* Rosfelder, Andre M. 07524

07328 **Marti, Kurt.** Trapped argon, krypton, and xenon in meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 116, 1967.

Martin, Larry D. *See* Tanner, Lloyd G. 02474

02380 **Marvin, Richard F.** Transcontinental geophysical survey (35°–39° N)—Radiometric age determinations of rocks: U.S. Geol. Survey Misc. Geol. Inv. Map I–537, scale 1:7,500,000, separate text, 1968.

Because all radiometric ages given by samples could not be shown adequately on the four maps, the text presents a tabulation of both plotted and unplotted ages and their localities. Generally only the Pb–207:Pb–206 age is given, although many Pb–206:U–238, Pb–207:U–235, and Pb–208:Th–232 ages are listed in the references cited for the Pb–207:Pb–206 age. Most analyzed materials are from igneous rocks, some are from metamorphic, and a few from sedimentary rocks. Data are presented alphabetically by State, and within the State, by age, but listed systematically under

the appropriate time division according to longitude–latitude designation. The rock type is reported as an aid in evaluating the possible areal extent of the listed age or ages.—MCM

02342 **Mason, Brian; Nelen, J.** The Weatherford meteorite: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 661–664, illus., table, 1968.

The Weatherford meteorite is a highly shocked breccia of nickel–iron (5.81 percent Ni), clinoenstatite and forsterite, and a Type III carbonaceous chondrite. Silicate material makes up about half of the meteorite by weight. The composition of the non-magnetic portion of the meteorite is given.—*from* Authors' abstract

02563 **Mason, Brian; Berry, L. G.** Elements of mineralogy: San Francisco and London, W. H. Freeman and Co., 550 p., illus., tables, revised 1968; originally published 1959.

Emphasis is given to general principles and to the significance of mineralogical data in interpreting geological phenomena. The first 200 pages are devoted to concepts, divided into seven chapters: an introduction, crystallography, chemistry and physics of minerals, their genesis, determinative mineralogy, and systematics, the species concept. Part 2, descriptions of some 200 minerals, is divided into eight chapters, each devoted to a class of minerals. Determinative tables comprise the third and last part. The chapter on crystallography has been shortened, a section on refractive index determination of nonopaque minerals is added, and optical data are incorporated into mineral descriptions and determinative tables.—ESL

Matten, L. C. *See* Sebby, W. S. 02344

02345 **Matten, L. C.** A Middle Devonian flora from New York [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

02429 **Matten, Lawrence C.** *Actinoxylon banksii*, gen. et sp. nov.—A progymnosperm from the Middle Devonian of New York: Am. Jour. Botany, v. 55, no. 7, p. 773–782, illus., 1968.

The new plants are based upon pyritic petrifactions and are from near Cairo, New York. The leaf, ultimate branch, and pentultimate branch are present. Details of the structures are given. *Actinoxylon* is compared with the progymnosperms *Actinopodium, Svalbardia, Archaeopteris, Siderella*, and *Tetraxylopteris*, with which it has features in common.—HRC

Matumoto, Tosimatu. *See* Boucher, Gary. 02359

07431 **Mauger, Richard L.** A summary of isotopic ages of Colorado Plateau, Utah, mineral deposits, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 91–98, illus., tables, 1967.

Isotope ages based on the ratios U–238:Pb–206, U–235:Pb–207, and Pb–207:Pb–206 for various uranium ore deposits in southeastern Utah are listed. There is considerable discordance in the results, indicating that one or the other of the products has been added or leached during geological time. Classical field criteria remain as the best method of age determination for these deposits. The LaSal intrusion, which has controlled some of the ore concentration, is dated at 25 m.y.—HRC

07329 **Mazor, E.; Heymann, D.; Anders, E.** Solar and planetary noble gases in carbonaceous chondrites [abs.]: Meteoritics, v. 3, no. 3, p. 117–118, 1967.

07330 **McCall, J. L.; Maringer, R. E.** Some metallurgical observations on the metallic phases in selected chondrites [abs.]: Meteoritics, v. 3, no. 3, p. 118–119, 1967.

McCall, J. L. *See* Buchheit, R. D. 07453

McCann, D. M. *See* Buchan, S. 07392

McCauley, John F. *See* McKenzie, John C. 02555

07390 **McClelland, Bramlette.** Progress of consolidation in delta front and prodelta clays of the Mississippi River, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 22–40, illus., tables, 1967.

The huge mass of late Quaternary clay on the continental shelf off southeastern Louisiana, which ranges up to several hundred feet in thickness, varies widely in its state of consolidation under existing overburden pressures. The void ratio, and therefore, the liquidity index of this deposit are shown to be functions of liquid limit and effective consolidation pressure. Comparison of the existing liquidity index with a computed liquidity index representative of normal consolidation is shown to provide a useful indicator of the state of consolidation, one which is consistent with depositional history of the area. Conditions identified by this means range from underconsolidated sediment 255 feet thick, near South Pass, to deposits which exhibit overconsolidation due to removal of 40 feet of sediment, south of Timbalier Bay.—Author's abstract

07331 **McCorkell, R.; d'Amico, J.** The cosmic ray produced radionuclides and the terrestrial age of the Hoba West meteorite [abs.]: Meteoritics, v. 3, no. 3, p. 119, 1967.

02487 **McCormick, C. D.; Picard, M. Dane.** Sedimentary structures and paleocurrents of Gartra Member (Triassic), Uinta Mountain area, Utah and Colorado [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 20, 1968.

02556 **McFall, C. Carew.** Reconnaissance geology of the Concepcion Bay area, Baja California, Mexico: Stanford Univ. Pubs. Geol. Sci., v. 10, no. 5, 25 p., illus., tables, geol. map, 1968.

As mapped, Cretaceous "granite" appears on Concepcion Peninsula; Oligocene and Miocene volcanics of the Comondú Formation are widespread, veneered locally by Pliocene marls and coquinas. The Comondú is here made a Group, its six formations described. These are intruded by small gabbro stocks and related diorite dikes; a large tonalite stock underlies the most rugged part of the Peninsula. Three K–A ages are presented, on igneous and tuffaceous rocks. The whole area has been considerably faulted, gently folded, repeatedly uplifted, and deeply eroded. Marine terraces are 20 to 950 feet and erosion surfaces, marine(?), up to 3,000 feet above sea level. The NW-trending fault zone, delineating the Gulf coast of Baja California, passes through Concepcion Bay; displacement for a San Andreas type right lateral offset is 19 miles. Manganese associated with travertine has been mined.—GDC

02247 **McGarr, Arthur; Vorhis, Robert C.** Seismic seiches from the March 1964 Alaska earthquake: U.S. Geol. Survey Prof. Paper 544-E, p. E1–E43, illus., tables, 1968.

Following the March 1964 Alaska earthquake seismic seiches were recorded at more than 850 gaging stations, most of which were in North America, especially in states bordering the Gulf of Mexico. Seiches, caused by the horizontal acceleration of seismic surface waves, occurred primarily on bodies of water whose natural periods of oscillation ranged from about 5 to 15 seconds. Occurrence of seismic seiches is found to be controlled by large-scale geological features such as the sedimentary deposits along the Gulf Coast and the Rocky Mountains. The distribution of seismic seiches provides unique information concerning the effect of various geological features on the propagation of seismic surface waves.—AM

02524 **McGowran, Brian.** Reclassification of early Tertiary *Globorotalia*: Micropaleontology, v. 14, no. 2, p. 179–198, illus., 1968.

Globorotalia sensu lato embraces two allochronous radiations from the same generalized stock based on *Subbotina pseudobulloides*. *Globorotalia* is restricted herein to the second, mainly Neogene, radiation. *Truncorotaloides*, expanded, parallels *Globorotalia* in test form but *Globigerina* in wall structure. The subfamily Truncorotaloidinae accordingly is retained, and three subgenera are recognized.

Planorotalites parallels *Globorotalia* in test form and wall structure, and therefore is retained in the Globorotaliinae. Transition and parallelism suggest reunion of all these taxa in the Globigerinidae.—Author's abstract

McKee, Edwin H. *See* Stewart, John H. 02274

02555 **McKenzie, John C.; McCauley, John F.** Geology and kyanite resources of Little Mountain, South Carolina: South Carolina Div. Geology Bull. 37, 18 p., illus., tables, geol. map, 1968.

In the structurally complex Little Mountain and Cannon Hills ridge, thin beds of kyanite quartzite interbedded with mica schists typical of the lower Carolina Slate Group, are offset horizontally, up to 1500 feet, by several normal faults near which is sulfide mineralization. Kyanite occurs as disseminated poikilo blastic grains, large subhedral crystals in irregular pods, and in small veinlets. Quartz, 85 percent of the rock, is in a strained granular mosaic with crystal elongation parallel to bedding; pyrophyllite abundantly replaces kyanite and is in isolated veins; traces of columbium, tantalum, gold, and silver are detected. Metamorphosed sedimentary rocks are inferred from conformable layering and heavy minerals; kyanite formed during regional metamorphism, with local recrystallization induced by subsequent fracturing; later aqueous solutions formed pyrophyllite, lazulite and pyrite.—GDC

07517 **McKenzie, K. G.** The distribution of Caenozoic marine Ostracoda from the Gulf of Mexico to Australasia, *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 219–238, illus., 1967.

During the Tertiary, the Tethys played a significant role in distribution of marine ostracode faunules in the Caribbean, Mediterranean, Indo-Pacific and Australasian provinces by allowing a relatively rapid dispersion of genera during the Paleogene. The corridor gradually disrupted until Mediterranean faunules were replenished mostly via Gibralter from Atlantic species. When open, the Panamanian Straits provided access to the Pacific coast of America for many Caribbean forms. The period witnessed a major adaptive radiation among Ostracoda for which no single region provided the principal locus. Some migrated passively, some temporarily then returned, some no longer inhabit former domiciles, some range widely or discontinuously, and some have become cosmopolitan, as phytal associates from more temporal regions or deeper water.—GDC

McMurtrey, R. G. *See* Reed, T. E. 02561

McNeely, R. N. *See* Lewis, C. F. M. 07364

02363 **Merifield, P. M.; Lamar, D. L.** Sand waves and early Earth-Moon history: Jour. Geophys. Research, v. 73, no. 14, p. 4767–4774, illus., table, 1968.

The geologic record may provide a test for recent suggestions that the Moon became an Earth satellite within the last 2 b.y., at an initial distance one-half to two-thirds of the present distance. It is shown that cross strata produced by migrating sand waves should be abundant in marine sandstones and calcarenites formed directly after the origin of the Earth-Moon system and should be less abundant throughout the remainder of geologic time. The presence of abundant large-scale cross strata and other characteristics of the late Precambrian marine shelf sediments of eastern California could be explained by increased tidal currents. Marine shelf sediments of this age throughout the world should show similar evidence of a high-energy environment if the Earth-Moon system originated in the late Precambrian.—*from* Authors' abstract

Merriam, Daniel F. *See* Harbaugh, John W. 02562

02391 **Merrill, Robert H.; Rausch, Donald O.** Slope stability, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 773–790, illus., 1968.

The angle at which a slope will safely stand is of major economic importance to the open pit operator. Discussion of the application of soil mechanics to slope

stability includes the general concepts, the computation of soil slope angles, and properties and tests of soils. That for rock mechanics includes the general concepts, methods of stress and strength evaluations, and instrumentation.—ESL

02232 **Metzger, William J.; Barnard, Walther M.** Transformation of aragonite to calcite under hydrothermal conditions: Am. Mineralogist, v. 53, nos. 1–2, p. 295–299, illus., 1968.

Reaction rates for the transformation of aragonite to calcite were studied hydrothermally at 800 bars and 100°–300°C. The data indicate that below 100°C, aragonite could persist in a sediment for several million years, but that with increasing temperature, aragonite is destroyed. The persistence of aragonite in highly metamorphosed rocks may be due to the absence of an aqueous phase.—JSH

07506 **Meyboom, Peter.** Hydrogeology, Chap. 2 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 30–64, illus., tables, 1967.

Hydrogeology can be used either as an auxiliary to geology, or in a wider sense as the study of part of our natural environment; the outline of principles and methods presented in this chapter reflects this dual nature of the subject. The fundamental working hypothesis of either approach is the continuity of the hydrologic cycle; prime concern of investigations is how this continuity manifests itself, how it influences other natural phenomena, and how it can be used advantageously in studying nature. Under principles, this chapter defines terms in detail, energy conditions of fluids in porous media, physical characteristics of both the medium and the fluid, and fluid flow under energy gradients; under methods, it discusses the cycle of research, and summarizes the sequence of activities.—GDC

07510 **Meyboom, Peter.** Interior Plains hydrogeological region, Chap. 6 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 131–158, illus., tables, geol. maps, 1967.

This region in Alberta, Saskatchewan and Manitoba, lies south of the limit of discontinuous permafrost. Published hydrogeologic data differentiate glacial drift and bedrock, as does the present description. Nearly horizontal strata of Paleozoic, Mesozoic, and Tertiary age are widely covered by Pleistocene till, lacustrine sediments, and outwash deposits. Their gross distribution and grain sizes are summarized; their landforms and low permeability affect the ground-water regime. Buried bedrock valleys, broad and deep, have good basal gravel aquifers. One map in pocket shows regional distribution of the bedrock hydrogeologic units; another, the hydrochemistry of their shallow aquifers. Data on deep aquifers are tabulated. Brine springs occur in Manitoba, in Devonian strata near contact with the Precambrian Shield.—GDC

02599 **Miller, Barry B.** *Planorbula campestris* (Gastropoda: Planorbidae) from the Cudahy fauna (Kansan) of Meade County, Kansas, with notes on the status of the subgeneric categories of *Planorbula* [with Spanish and Russian abs.]: Malacologia, v. 6, no. 3, p. 253–265, illus., tables, 1968.

Over 200 fossil shells of this species have been collected from the Kansan Pleistocene Cudahy fauna; study of these, and of all Recent *P. campestris* and *P. armigera* in collections of the U.S. National Museum and University of Michigan, reveals previously unreported characteristics to distinguish the species: multiple sets of denticles, <4 in *P. campestris* and <2 in *P. armigera*; <5 and <6 denticles per set, respectively; incised spiral striae strongly developed in *P. campestris*, weakly developed and discontinuous in *P. armigera*. These characteristics are at least as important as the shape of the lower palatal lamella used by F. C. Baker (1945) to distinguish the subgenera *Planorbula* s.s. (including above species) and *Haldemanina*; validity of these subgeneric categories is questioned.—VMJ

02306 **Miller, C. N.** A new species of petrified pine cones from the Oligocene of Montana [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 727, 1968.

Miller, C. P. *See* Swinney, C. M. 02381

Milnes, A. G. *See* Distelhorst, Carl A. R. 02280

02542 **Mintzer, Olin W.** Soils, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 425–430, illus., 1968.

Specific studies in use of color and color infrared film for photogeological surveys are cited, with two comparative figures showing color tones of soft subsoil terrain. In engineering soils and landslide studies, the airphoto interpreter uses color infrared film to develop data concerning the landform, drainage system, and vegetative cover; and color aerial film to develop descriptive information concerning the gully shape and gradient, erosional features, and natural color tones in terms of the soils. When cultural and special features are specific indicators of terrain conditions, the interpreter uses both color and color infrared aerial photography. The combined interpretation of panchromatic, color, and color infrared aerial photography and field survey data results in the most economical investigation.—GDC

02354 **Mirkovich, V. V.** Experimental study relating thermal conductivity to thermal piercing of rocks: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 3, p. 205–218, illus., tables, 1968.

Thermal conductivity of 19 selected Canadian rocks was measured to determine the effect of thermal conductivity on thermal piercing of rocks. Rocks with higher thermal conductivity generally tend to pierce better, but a definite relation could not be established. However, a very good correlation was obtained between the thermal piercing rate and the product of thermal diffusivity and thermal expansion.—Author's abstract

02516 **Misch, Peter.** Plagioclase compositions and non-anatectic origin of migmatitic gneisses in Northern Cascade Mountains of Washington State: Contr. Mineralogy and Petrology, v. 17, no. 1, p. 1–70, illus., tables, 1968.

Compositions and zoning of plagioclase in components of the Skagit Gneiss indicate that this feldspar was derived from leucocratic migmatitic gneisses by metamorphic recrystallization, ruling out igneous injection as the chief agent in migmatization. Anatectic origin is unlikely for these gneisses for eight reasons: the wide range in plagioclase composition up to calcic andesine, lack of major K-plagioclase in most gneisses, bulk compositions far from lowest melting in the granite system, no wholesale basification of schist and amphibolite remnants, ratios of leucocratic gneiss to remnants too high for split off, a sequence of migmatization opposite to that expected in progressive anatexis, a solid-state history of deformation and recrystallization similar in gneisses and remnants, and a too low metamorphic grade.—GDC

07375 **Missouri Speleological Survey.** Texas County: Missouri Speleology, v. 9, no. 3, p. 35–43, illus., 1967.

Texas County, the largest in Missouri, lies on the western flank of the Ozark uplift. Bedrock is almost entirely carbonate strata of the Ordovician Canadian Series. The Gasconade Dolomite at the base of the series has more caves than any other formation in the State; there were 60 caves on record in the County as of January 1967. Most caves are in bluffs along major valleys, and very few have attained moderately large size. Three caves are described, including maps.—ESL

07376 **Missouri Speleological Survey.** Warren County: Missouri Speleology, v. 9, no. 3, p. 44–60, illus., 1967.

Rocks exposed in Warren County are mostly Ordovician and Mississippian, dipping northeast with slight folds. The caves present include a number of sandstone caves and shelters, formed by solution of calcareous cores, or by solution along a dolomite-sandstone interface, with corrasion playing an important part in later stages of both types. Eight caves (including maps), are described by Lang Brod, Bob McKelvey, and C. F. Curren.—ESL

Mitchell, Edward. *See* Lipps, Jere H. 02202

Mizutani, Hitoshi. *See* Fujisawa, Hideyuki. 02331

02379 **Mollard, J. D.** Landform analysis, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 406–407, illus., 1968.

A color airphoto shows a small portion of the floor of former Champlain Sea near Montreal, with overlay marking features; for interpretation, a good deal of field correlation is desirable. Lacking relief, landform boundaries are rarely abrupt, glaciomarine and alluvial deposits over moraine are patchy smears, and depressions are filled with seasonably wet peat and muck. Chief distinguishing features of deeper marine clay are sub–parallel curvilinear microrelief ridges of more uniform tones; of marine or alluvial sands, variations in tonal pattern. Lighter tones are associated with greater permeability; dark spots with organic depressions. Till is characterized by stronger undulating topography, light tones of knoll tops, absence of curvilinear depressions, and layers of differing deposits by a combination of indicators.—GDC

07332 **Monnig, Oscar E.** The discovery of the Tishomingo, Oklahoma, siderite [abs.]: Meteoritics, v. 3, no. 3, p. 120, 1967.

Moore, James G. *See* Evans, Bernard W. 02276

02203 **Moore, Paul B.** Relations of the manganese–calcium silicates, gageite and harstigite: Am. Mineralogist, v. 53, nos. 1–2, p. 309–315, tables, 1968.

Gageite from Franklin, New Jersey, and harstigite from Värmland, Sweden, appear to be related crystallochemically, with a_h about a_g, b_h about b_g, c_h about $3c_g$. The formula unit is $[X_7(OH)_4(Si_3O_{10})]^{2+}$, where X is essentially Mn for gageite and Ca for harstigite. The two minerals may be prototypes of the prehnite structure or possibly even structures composed of the Si:O = 3:10 triple groups of linked tetrahedra.—MEM

07460 **Moore, R. G.** Lithostratigraphic units in the upper part of the Windsor Group, Minas sub–basin, Nova Scotia [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 245–266, illus., 1967.

Within the upper Windsor Group in the Minas sub–basin, seven distinctive limestone members, described and shown in stratigraphic columns, have wide geographic distribution, remarkable lithologic and faunal homogeneity, and tabular or wedge form. Five are named herein: Herbert River at base, western–restricted Brooklyn Station and eastern Shubenacadie River, the Meander River, and Wallace Point Limestones. The units previously named Avon, in middle, and Kennetcook, at top, are redescribed. Two recurrent depositional cycles are recognized, their differences probably related to tectonic stability, bottom conditions, and kinetic energy of transport. Isopach, lithofacies and biofacies trends, indicate a broadly U–shaped depositional strike, as shown on limestone outcrop maps, with deeper–water conditions near center and the basin deepening to the north or northeast.—GDC

Morelock, Jack. *See* Bryant, William R. 07391

Morey, E. D. *See* Morey, P. R. 02309

02309 **Morey, P. R.; Morey, E. D.** Observations on epon–embedded Griffin Hill Peat, Two Creeks *Picea, Cedrus penhallowii,* and *Callixylon* [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 722, 1968.

07532 **Morgenstern, N. R.** Submarine slumping and the initiation of turbidity currents, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 189–220, illus., tables, 1967.

Conditions under which submarine slumping has occurred are reviewed and agencies causing them are discussed; special attention is given to earthquake effects. Slumps can result in a wide variety of sedimentary structures, many of which are associated

with liquefaction. Strength of sediments is considered; influence of underconsolidation due to high sedimentation rates on strength of marine sediments is treated in detail. Mechanics of slumping are analyzed from the point of view of both drained and undrained failure. It is thought that some slumps transform into high-density turbidity currents. Evidence for existence of such currents is summarized and a theory presented to show that a slump can achieve sufficiently high velocities to transform into a turbidity current if pore pressures induced at failure are high enough.—*from* Author's abstract

02207 **Morse, S. A.** Revised dispersion method for low plagioclase: Am. Mineralogist, v. 53, nos. 1–2, p. 105–115, illus., tables, 1968.

Revised cleavage flake curves for low plagioclase determination are derived from the refractive indices of Smith (1960), which are applied to the indicatrix orientations of Tsuboi (1923) or Slemmons (1962). A new dispersion chart, based on the alpha prime (001) curve, allows use of the much-neglected dispersion method, which affords good statistical information and is capable of a standard errors ($s/(n)1/2$) of ±0.1 percent An under exceptional conditions.—Author's abstract

Mortland, M. M. *See* Parfitt, R. L. 02254

07455 **Moss, A. A.; Hey, M. H.; Elliott, C. J.; Easton, A. J.** Chlorine as a reagent in meteorite analysis [abs.]: Meteoritics, v. 3, no. 3, p. 120–121, 1967.

02196 **Mound, Michael C.** Upper Devonian conodonts from southern Alberta: Jour. Paleontology, v. 42, no. 2, p. 444–524, illus., 1968.

Several diverse conodont faunas were recovered from cores from six deep wells in south-central Alberta. More than 3,200 identifiable specimens distributed among 107 species assigned to 35 genera were identified from the Upper Devonian Beaverhill Lake Formation, the Woodbend and Winterburn Groups (Frasnian), and the stratigraphically higher Wabamun Group (Famennian). The faunas correspond to other North American and western European faunas of similar age and include various widely distributed species of *Apatognathus, Ancyrodella, Ancyrognathus, Enantiognathus, Falcodus, Hibbardella, Icriodus, Nothognathella, Palmatodella, Palmatolepis, Pelekysgnathus,* and *Polygnathus.* These and other characteristic species demonstrate a typical Upper Devonian faunal sequence.—*from* Author's abstract

07341 **Mourad, A. G.** The concept of marine geodesy, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 27–35, illus., 1967.

The use of marine control points and(or) networks as established by geodesy is examined for application to hydrographic, bathymetric, and geophysical surveys, and for navigation, oceanographic and meteorological surveys, and space and defense operations. Steps involved in establishment of marine control points are discussed. Long-range navigation systems currently used in providing geodetic control for deep-water operations and the marine gravity-base-station network established for control of airborne- and surface-ship-based surveys are mentioned briefly.—VSN

Muhammad, A. Rashid. *See* Wilson, L. R. 02500

Muller, Klaus J. *See* Clark, David L. 02184

02605 **Mundorff, J. C.** Fluvial sediment in Utah, 1905–65—A data compilation: Utah Dept. Nat. Resources Inf. Bull. 20, 21 p., illus.; 400 p. of tables, 1968.

Tables of basic data on suspended-sediment concentration and discharge, particle size of suspended sediment and bed material, and reservoir sedimentation surveys are presented. Data are given for 145 sediment stations on streams, including a few sites in nearby parts of adjacent states, and for 30 reservoirs. The compilation is believed to be sufficiently complete to serve as a basis for evaluating the adequacy of sediment data for different parts of the State and as a basis for planning future

needs. Modern sediment investigations should include not only information on the quantity and particle size of the transported sediment but also information on the mineralogic and ion-exchange characteristics, the quantity and characteristics of the organic fraction of the sediment, and possible effects of the sediment on the chemical and biological quality of the water.—GDC

07494 **Murray, Bertram G., Jr.** Grebes from the late Pliocene of North America: Condor, v. 69, no. 3, p. 277–288, illus., tables, 1967.

Evidence is presented for the existence of at least four species of grebes in western North America in the late Pliocene: *Pliolymbus baryosteus, Podiceps discors, Aechmophorus elasson*, and *Podilymbus majusculus*. Because no modern species of grebe is known certainly to exist before the Pleistocene and because the late Pliocene grebe fauna is now known to be different from and as diverse as the modern fauna, modern grebes probably first appeared sometime during the Pleistocene. Only one late Pliocene line of grebes, *Pliolymbus*, appears to have become extinct.—KAF

Murthy, V. Rama. *See* Griffin, W. L. 02440

Myers, J. *See* Welp, T. L. 02557

Nafziger, R. H. *See* Lindsley, D. H. 02450

Nafziger, R. H. *See* Speidel, D. H. 02545

02301 **Nakamura, Yosio.** Head waves from a transition layer: Seismol. Soc. America Bull., v. 58, no. 3, p. 963–976, illus., table, 1968.

Ultrasonic, seismic-model experiments to re-examine the nature of head waves from a transition layer have been performed on two-dimensional, layered structures, some with a transition zone and some with a sharp discontinuity, constructed by lead-aluminum laminations; amplitude and phase responses have been measured in a frequency range of 25 to 200 kHz. At low frequencies, where wavelength is much longer than thickness of the transition zone, little difference is observed between head waves from a transition zone and those from a sharp discontinuity. At a certain frequency range where wavelength is close to thickness of the transition zone, the measured head-wave amplitude from a transition zone becomes a few times larger than that from a sharp discontinuity. This is characteristic of head waves from a poorly defined boundary and may be used to estimate the thickness of a general transition layer.—*from* Author's abstract

Nason, Robert. *See* Tocher, Don. 07468

07470 **Nason, Robert; Tocher, Don.** Stone Canyon Observatory, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 105, 1967.

This observatory of the ESSA Earthquake Mechanism Laboratory is on the San Andreas fault, 30 km south of Hollister, Calif. Horizontal earth strains and tilts are measured, and a magnetometer, one of the array along the fault, is located here. Microearthquakes are monitored by three borehole seismometers, one in the fault. A creep-meter, designed at the laboratory, monitors slippage by measuring change in length of lines crossing the fault. Material in a cross section of the fault zone is a claylike plastic gouge with isolated blocks of serpentine and other rocks, sheared Monterey Formation, and pulverized granitic rocks. Montmorillonite is the predominant mineral, with considerable chlorite and serpentine; it could be a highly pulverized Franciscan assemblage.—ESL

Nason, Robert D. *See* Rogers, Thomas H. 07469

02231 **Nassau, K.** On the cause of asterism in star corundum: Am. Mineralogist, v. 53, nos. 1–2, p. 300–305, illus., table, 1968.

Natural and synthetic star corundums were examined to determine whether the cause for the asterism was the presence of needles of titanium dioxide or di-aluminum titanium pentoxide. Natural corundums were found to contain needles of titanium dioxide but synthetic corundums contained needles too small to analyze by electron probe. Phase equilibria are discussed and no unique conclusion is drawn.—JLH

Naughton, John J. *See* Funkhouser, John G. 02361

Naughton, John J. *See* Funkhouser, John G. 02531

07403 **Neale, E. R. W.; Williams, Harold.** (editors). Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, 292 p., illus., tables, 1967.

Some of the 14 papers in this collection deal with geological problems common to all four of Canada's Maritime Provinces; others more areally restricted include details of original research and a comprehensive review of various fields of interest. A summary of the Canadian Appalachian region, its tectonic elements and proposed correlations, is followed by a history of the Atlantic continental margin south to Bahama Banks, then the stratigraphy of the Scotian shelf. Six papers on Newfoundland cover all Silurian rocks, details of several other formations, and mineral deposits in lavas of Halls Bay mining district. A regional review of Carboniferous stratigraphy of the Atlantic region is followed by details of the Windsor and Pictou Groups, and lastly, geophysical indicators of a pre-Carboniferous graben off eastern New Brunswick. Papers are cited separately.—GDC

07457 **Neale, E. R. W.; Kennedy, M. J.** Relationship of the Fleur de Lys Group to younger groups of the Burlington Peninsula, Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 139–169, illus., 1967.

This region is underlain by various sedimentary, volcanic, and plutonic rocks, correlated chiefly by lithology and relative structural complexity. Scanty fossil data and three isotopic ages served to establish Ordovician and Silurian sedimentary rocks, to suggest pre-Ordovician schists and gneisses, and to indicate some Devonian intrusion and metamorphism. Three phases of intense metamorphism appear in the Fleur de Lys Group, both in the type area and near Mic Mac Lake. At Pacquet Harbour overlying basic metavolcanics, originally assigned to the Baie Verte Group, are more complex and now considered older. Their fault boundary, recently disputed, tends now to be accepted. Previous lithologic correlations are negated, and a Silurian age is favored for both groups.—GDC

Nelen, J. *See* Mason, Brian. 02342

02469 **Nelson, Robert B.** Structurally controlled amphibolitization of a kersantite sill [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 20–21, 1968.

Nestell, Merlynd K. *See* Bostwick, David A. 07521

07333 **Nettleton, L. L.** The economic motivation—Geology and geophysics for oil and mineral exploration, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 261–268, illus., 1967.

The principles of seismic, gravity, and magnetic surveys developed on land have been extended to geophysical exploration for oil at sea. The field of application is primarily on the continental shelves in water depths of 600 feet or less. This paper outlines the methods used, the geodetic requirements, the exploration costs, and the importance of marine geodesy in these costs. Production figures and reserves established off Louisiana show that more has been expended in exploration than has yet been returned.—VSN

02458 **Newcome, Roy, Jr.** Geology and ground-water resources of the Pascagoula River basin, App. K, *in* Pascagoula River comprehensive basin study, V. 6: [Mobile, Ala.] U.S. Army Corps Engineers, p. K1–K34, illus., tables, 1968.

(omitted in error from Abstracts of North American Geology, December 1968)

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Abundant ground-water resources underlie the Pascagoula River basin, developed intensely only in the Mississippi areas of Hattiesburg, Laurel, Meridian, and Pascagoula. The fresh-water-bearing section is Eocene to Recent sand and clay, 300 to 3500 feet thick. The Claiborne Group provides water for all purposes in the northern third of the basin, underlain by the potentially important but virtually untapped Wilcox Group. Miocene aquifers supply most of the southern half, and Pliocene the Jackson County area. Flowing wells are common in valleys and near the coast. Potential pumpage is many times the estimated 60 mdg; excessive drawdown, in a few places, could be alleviated by redistribution of pumpage. Water is generally of excellent quality, although the coastal area has a potential for salt-water encroachment.—GDC

Newton, J. G. *See* Causey, L. V. 07405

Newton, John G. *See* Reed, Philip C. 07406

02501 **Nichols, Clayton R.** Control of the "microenvironment" on the clay mineralogy of an alteration sequence [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 119-120, 1968.

07402 **Nichols, Harvey.** The post-glacial history of vegetation and climate at Ennadai Lake, Keewatin, and Lynn Lake, Manitoba (Canada) [with German abs.]: Eiszeitalter u. Gegenwart, v. 18, p. 176-197, illus., 1967.

Peat from Keewatin and Manitoba contains macrofossil and palynological evidence of former latitudinal movements of the forest-tundra boundary, probably in response to changing mean summer position of the Arctic front. The late-Wisconsin ice sheet melted rapidly between 8000 and 6000 years ago, with swift immigration of *Picea*, and no evidence of tundra vegetation after deglaciation. From 6000 to 3500 years ago the Boreal forest extended far north of its present limit, with a short-lived cool phase about 5000 years ago; cooler and variable climatic episodes followed after 3500, and deterioration about 2600 years ago. Amelioration, 1500 and 600 years ago, was followed by a prolonged cold episode terminating peat growth in the tundra. From the changing forest limits, approximate mean summer temperatures have been estimated, radiocarbon dates for which coincide with a number of climatic changes in northwest Europe.—*from* Author's abstract

Nickle, Neil L. *See* Dunne, James A. 07472

07500 **Nikitina, N. D.** Svyaz' vulkanizma s formirovaniyem neotektonicheskikh struktur (na primere Gavayskikh ostrovov): Zhizn' Zemli, no. 4, p. 32-38, illus., 1967.

The Hawaiian Islands are situated in that part of the Pacific Ocean where "grid" structure of the oceanic lithosphere is clearly expressed. It is suggested here that the grid structure of the crust is also visible on a smaller scale on the islands themselves. The volcanoes are built up along northeast- and northwest-trending rifts. Those fragments of planetary structures, the Hawaiian Islands and Iceland, have some analogous features.—DBV

02193 **Nitecki, Matthew, H.; Sadlick, Walter.** Notable color patterns in a fossil brachiopod: Jour. Paleontology, v. 42, no. 2, p. 403-405, illus., 1968.

Three specimens of a Late Mississippian pseudopunctate brachiopod, *Orthotetes kaskaskiensis* (McChesney), exhibit a rare, though altered, color pattern. The alternating, concentric white and gray banded pattern parallels the growth laminae. These rare color bands are interpreted as the reverse of the original pigmented bands. A high qualitative correlation between heavily pigmented color bands and growth increments, which are present in regular circumferential bands, indicates that the shell growth of some brachiopods is periodic.—*from* Author's abstract

02235 **Noble, Donald C.** Optic angle determined conoscopically on the spindle stage—[Pt.] 2, Selected rotation method: Am. Mineralogist, v. 53, nos. 1-2, p. 278-282, illus., 1968.

The spindle axis is placed parallel to a crosshair and a melatope is placed in the crosshair by rotation about the spindle axis. Rather than using a micrometer ocular as in Part I (Wilcox, R. E., ibid., p. 269–277), the spindle axis is then placed at a known angle to the crosshair by rotating the microscope stage, and the amount of rotation about the spindle axis required to return the melatope to the crosshair is found. The complement of the angle between the optic axis and the spindle axis is readily determined from these two angles and thence the optic angle. Author's abstract

Norris, Roger A. *See* Johnson, Rockne H. 02292

02250 **Nriagu, Jerome O.** The distribution of iron in lake sediments: Wisconsin Acad. Sci., Arts and Letters Trans. 1967–68, v. 56, p. 153–164, illus., tables [1968].

In Lake Mendota [Wisconsin] sediments, iron is present as the sulfides (hydrotroilite and/or greigite), in organic material, detrital material, magnetic spherules and as "acid-soluble" iron which has been shown to be coprecipitated with calcite (the predominant mineral phase in lake muds) by adsorption. A small fraction of the acid-soluble iron may also be tied up as the polyphosphates. [Grab samples dredged along a traverse between Picnic Point and Maple Bluff, and core samples obtained near University Bay were used for analyses presented.]—Author's abstract

Nye, J. F. *See* Untersteiner, N. 02503

Nygreen, P. W. *See* Clendening, J. A. 02350

Odell, R. T. *See* Frazee, C. J. 02237

02239 **Ogburn, Charlton, Jr.** The forging of our continent: New York, Am. Heritage Publishing Co. (in association with Smithsonian Inst.), 154 p., illus., 1968.

Subjects covered are: the ancestral rocks; the cycle of contest, including the Earth's interior, origin of granite, erosion, sedimentary rocks, and volcanoes; early insights; the Appalachians; exploration of the West; the Rocky Mts.; volcanism and faulting in the West; fault-block mountains and basins, including canyons; glaciation; and the hungry sea. National Parks and Monuments revealing geologic history are listed and described. Chronology, including fossils and important events, comprises another section, and a glossary and recommendations for further reading conclude the book.—ESL

Oliver, Jack. *See* Boucher, Gary. 02359

02277 **Olson, Gerald W.; Hole, Francis D.** The fragipan in soils of northeastern Wisconsin: Wisconsin Acad. Sci., Arts and Letters Trans. 1967–68, v. 56, p. 173–184, illus., table [1968].

A brittle subsoil fragipan, widespread in upland soils of northern Wisconsin, particularly in the northeast, restricts root growth and movement of water, and is therefore important to an understanding of the ecology of forests and hydrology of the drainage basins. This horizon has developed under various climates, in materials including Wisconsin loess, glacial till and lacustrine deposits, by compaction of a mixture of noncalcareous silts and sands with little clay and low content of organic matter. Studies in selected counties reveal that the low content of clay and its peculiar distribution in the fragipan allow for bridges and menisci of clay in contacts between sand and silt; some voids may be the result of eluviation of clay in the pre-fragipan stage.—GDC

02401 **Olsson, Axel A.; Petit, Richard E.** Notes on *Siphocypraea*: Bulls. Am. Paleontology, v. 54, no. 242, p. 279–285, illus., 1968.

Siphocypraea sensu stricto and *Muracypraea* are members of the same generic group and represent two lineages which probably arose in Oligocene and became fully differentiated in the Miocene. *Muracypraea* has the widest distribution, and typically is found throughout the Miocene of the Caribbean, the eastern Pacific, and Java. It may be of Tethyan origin with a worldwide distribution. *Siphocypraea s.s.* is

a special development from the same stock and is probably endemic to the Miocene of the southeastern United States. In Pinecrest beds (Duplin) of south Florida, the group proliferated and gave rise to many variable, intergrading forms. The subgenus became stabilized in Caloosahatchee marls in *S. problematica*, its most advanced species, and became extinct at the close of Caloosahatchee time.—MST

07417 **Oray, E.; Sanderson, D.** Application of the gravity method to the study of a collapse feature in Grand Rapids, Michigan: Compass, v. 45, no. 1, p. 6–10, illus., 1967.

Application of a precise gravity survey to delineate a solution type collapse feature in a residential area of Grand Rapids, Michigan, is described.—Authors' abstract

02538 **Ore, H. Thomas.** Preliminary petrographic analyses of the sediments at the Wasden site (Owl Cave): Tebiwa, v. 11, no. 1, p. 37–47, illus., tables, 1968.

This lava-tube cave fill in eastern Idaho was studied to determine zones unusual enough for lithologic correlation, or use as time-horizon markers. In terms of grain size, carbonate, strontium, iron and heavy mineral content, diagenesis including intrastratal solution by ground-water action accounts for all observed changes. No effects are noted from long-term changes in source rock type, or climate at source area or depositional site, nor in ground-water regime. The protected depositional environment probably ameliorated microclimatic extremes. Besides overall changes, groups of samples show characteristics different from materials above or below. The bone-bearing layer causes the strongest variation in parameters, with no consistent strong sediment variation to explain local involutions; without the bones this layer might not show up.—GDC

07343 **Orlin, H.** Marine gravity surveying instruments and practice, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 181, illus., tables, 1967.

The introduction of sea gravimeters has led to a new era in marine gravimetry; with improved underwater meters, measurements can be made to depths of 3,000 and 4,000 feet with an accuracy of 0.02 mgal. Various instruments that are available, the type of results obtainable, and the techniques used, are described briefly and illustrated.—VSN

02488 **Orr, Donald G.** Multiband-color photography, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 441–450, illus., 1968.

Since many earth materials reflect energy differently over the photographic spectrum, the contrast between materials of interest and the background should be enhanced by selection of proper film-filter combinations. Various factors to be considered are summarized. The multiband technique offers a wide range of flexibility in collecting, analyzing, and display of spectral information within the photographic spectrum (limited here at 2,900A to 11,000A). Its advantages include: capability for flexible selection of spectral bands of optimum performance; film sensitivity, exposure latitude, and resolution of black and white emulsions; simpler and faster processing; multiple color displays and enhancements (as illustrated); and color balance, fidelity, and exposure latitude adjustment in processing and display.—GDC

07492 **Owen, E. B.** Northern hydrogeological region, Chap. 8 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 173–194, illus., tables, 1967.

This region crosses all of Canada north of the southern limit of discontinuous permafrost as extensions of the glaciated Canadian Shield, centered by Hudson Bay, the Interior Plains with Mackenzie Lowland, and the Cordillera of Yukon. Scarce data permit only generalizations as to availability of ground water in supra-, intra-, or subpermafrost thawed zones. It may be obtained in the area of discontinuous permafrost, but its development farther north is frequently impractical if not impossible. Suprapermafrost water may be as much as 230 feet beneath lakes; confined by impermeable frozen ground, artesian conditions may exist in valleys.

Volume pumped from mines, and chemical analyses of water from scattered wells and 17 springs are tabulated. Large limestone solution cavities appear in bluffs along South Nahanni River, and in its upper valley (N.W.T.) are thermal springs.—GDC

02483 **Pabian, Roger K.** Biometric study of the development of the Pennsylvanian trilobite *Ditomopyge scitula* (Meek and Worthen) from Nebraska [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 21, 1968.

02582 **Pabst, Marie B.** The flora of the Chuckanut formation of northwestern Washington—The Equisetales, Filicales, Coniferales: California Univ. Pubs. Geol. Sci., v. 76, 85 p., illus., tables, 1968.

The Chuckanut Formation is of early Tertiary age, and possibly in part latest Cretaceous. The abundant leaf impressions and fructifications which make up the flora have been preserved in the finer sediments. The portion described consists of 1 genus of scouring rush, 14 genera in 7 families and 2 orders of ferns, and 5 genera in 2 families of conifers. Of the 22 species described, 12 species of ferns and 1 conifer are new; 2 fern genera have not previously been reported. One conifer is reassigned to another genus within the same family. Abundant associated angiosperms are not considered. Comparison with other Tertiary floras indicates that their closest affinity is with the Fort Union flora of Paleocene age, but any final age reference must include the evidence of the angiosperms. The flora is considered to have lived under ecotonal conditions between subtropical and warm temperate forests, with abundant rainfall and absence of frost.—*from* Author's abstract

02216 **Page, Norman J.** Chemical differences among the serpentine 'polymorphs": Am. Mineralogist, v. 53, nos. 1–2, p. 201–215, illus., table, 1968.

Existing wet chemical analyses and structural studies of the serpentine minerals, chrysotile, lizardite, and antigorite suggest that these minerals have different chemical compositions and could be identified by composition alone. Triangular composition diagrams, a statistical treatment of the oxide components, MgO, FeO, Fe_2O_3, Al_2O_3, and H_2O, and calculated mineral formulae from chemical analyses all suggest that chrysotile, lizardite, and antigorite are not polymorphs. Antigorite is distinguished by its comparatively low H_2O and high SiO_2 contents. Chrysotile is characterized by a relatively high H_2O and MgO content and by a small ratio of Fe_2O_3 to FeO; while lizardite has high SiO_2 and low FeO contents.—Author's abstract

02245 **Page, Robert.** Aftershocks and microaftershocks of the great Alaska earthquake of 1964: Seismol. Soc. America Bull., v. 58, no. 3, p. 1131–1168, illus., tables, 1968.

This study together with previous investigations reveals the following properties of aftershock sequences: (1) The frequency of occurrence of large aftershocks decays uniformly in time over an interval of months according to an inverse power law with an exponent greater than 1.0, (2) magnitudes of aftershocks and microaftershocks are distributed according to the Gutenberg and Richter magnitude frequency relation with a b value of 0.8–0.9, (3) prominent aftershock sequences characterized by these statistical properties occur only at shallow depths within the Earth's crust, (4) a single dominant body-wave radiation pattern is commonly associated with aftershocks occurring in a small region, and (5) a significant increase in aftershock activity in the form of a secondary aftershock sequence occasionally follows the occurrence of a large aftershock.—KAS

07519 **Palmer, Katherine V. W.** A comparison of certain Eocene molluscs of the Americas with those of the western Tethys, *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 183–193, illus., tables, 1967.

The marine Eocene of the Western Hemisphere includes molluscs with Tethyan affinities, that is, genera typical of the Tethys from Eurasian to the borderlands of the present Mediterranean, shallow-water forms indicating a tropical and subtropical climate. They indicate two main marine provinces, one that of the

pelecypod *Venericardia planicosta*, the other of the gastropod *Velates perversus*. The latter and associated genera reveal Tethyan affinities, and were discovered in St. Bartholomew, Jamaica, Florida, Canal Zone–Panamá, and California. In all areas except California, *Velates* occurs in limestones and not associated with *Venericardia planicosta*. In the California assemblage, *Velates* occurs in the Lower and Middle Eocene; in other localities the age is Middle(?), upper Middle, and Upper Eocene.—*from* Author's abstract

02398 **Pan, Cheh.** On the dynamical theory of polar wandering: Tectonophysics, v. 5, no. 2, p. 125–149, 1968.

A dynamic theory of polar wandering and continental drift is presented assuming that the Earth's outer shell is irregularly fractured, heterogeneous, and multilayered, has low thermal conductivity with lateral temperature variations in the layers, and continental accretion has occurred; asthenosphere-wide rather than mantle-wide convection is present; generation of thermal energy is or has been in excess of that removed by surface heat flow; and the surface temperature is constant in time and the outer shell has never been 'totally' molten. Catastrophic failures occurring before the upper asthenosphere is totally molten represent major release of disequilibrium energy and would occur repeatedly; thus all basic geologic phenomena are episodically induced. The immediate effect of failure is excitation of polar wandering and production of a torque causing lithosphere blocks to slide over the asthenosphere.—VSN

07412 **Papezik, V. S.; Fleming, J. M.** Basic volcanic rocks of the Whalesback area, Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 181–192, illus., tables, 1967.

Rocks of the Springdale Peninsula in northern Newfoundland are chiefly Ordovician basic lavas of submarine origin and associated pyroclastics, intruded by many gabbro dikes and sills. Tightly folded and cut by numerous faults, they appear to have been subjected to low grade metamorphism and relatively intense metasomatism. Petrographic studies and 17 new rock analyses combine to suggest two distinct groups: the Whalesback volcanic rocks, light green-grey pillow lavas relatively high in Ca, which are classified as tholeiitic basalts; and the St. Patrick volcanic rocks, dark green-grey, relatively rich in Na, which are classified as spilites by comparison with an average of 105 analyses of spilitic rocks. These two varieties of lava, apparently mappable, may serve to elucidate the complex structure of this copper-rich region.—*from* Authors' abstract

02254 **Parfitt, R. L.; Mortland, M. M.** Ketone adsorption on montmorillonite: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 355–363, illus., tables, 1968.

Ketone adsorption by montmorillonite was found to be greatly influenced by the nature of the exchangeable cation. Mechanisms of bonding included (1) direct dipole interaction of the carbonyl with the ion in cases where the ion had a low hydration energy or where special treatments were used to dehydrate the ion; (2) outer sphere coordination to the metal ion by bridging through directly coordinated water molecules; (3) formation of electrovalent bonds through proton donation by 2,4 pentanedione to the clay saturated with Al or Cu ions to form the acetylacetonates of these ions.—Authors' abstract

02600 **Parizek, Eldon J.; Howe, Wallace B.; Williams, James H.** Geologic map of Lees Summit quadrangle, Jackson County, Missouri: Missouri Div. Geol. Survey and Water Resources Geol. Quad. Map Ser., no. 1, scale 1:24,000, section, text, 1968.

Geologic mapping (on 7 1/2-minute topographic map base) with a brief description of exposed strata of Pennsylvanian (Missourian Series) and Quaternary (Pleistocene) age is presented for the Lees Summit quadrangle, which lies within an area currently subject to rapid urbanization. The exposed bedrock strata are essentially flat-lying. Economic resources in the area include limestone suitable for the production of concrete aggregate, shale as a raw material for brick manufacture, and minor amounts of oil and gas. Engineering studies show that sites suitable for sewage lagoons and other impoundments are mostly restricted to upland areas and to broad

alluvial valleys, and that in some areas swelling clays and shales may cause damage to poorly designed structures.—Authors' abstract

07396 **Parker, Garald G.; Jenne, E. A.** Structural failure of western highways caused by piping, *in* Symposium on subsurface drainage: Highway Research Rec., no. 203 (Natl. Research Council–Natl. Acad. Sci.–Natl. Acad. Eng. Pub. 1534), p. 57–76, illus., 1967.

Piping, a type of subsurface erosion most commonly observed in alluvium in arid and semiarid regions, also occurs in loess areas; it frequently results in pseudokarst topography. Three types based on mode of origin are: dessication–stress crack, entrainment, and variable permeability subsidence. The dominant type damaging highway structures in the west originates in dessication cracks. Requirements for this piping are: enough water to fill drainable cracks, strata that are montmorillonitic and dessicate thoroughly and an outlet for drainage. A number of examples of all types are described and illustrated, and preventive measures are discussed.—ESL

07436 **Patashnick, Harvey; Hemenway, Curtis L.** Mass and density measurements of micrometeorites [abs.]: Meteoritics, v. 3, no. 3, p. 121–122, 1967.

02513 **Pearson, Ross Norton.** Physical geography: New York, Barnes and Noble (Coll. Outline Ser.), 242 p., illus., tables, 1968.

This outline is designed for use in connection with courses in introductory physical geography, earth science, and general geography. A bibliography and reference table to standard textbooks are included. Subjects covered are: the field of geography, the planet Earth, climatic types, origins of surface features, major types of landforms, natural vegetation, soils, water resources, oceans and seas, fuel minerals, metallic minerals, and physical geography in perspective. World maps included show climate, landform types, vegetation types, and soil types.—ESL

Perlow, G. J. *See* Sprenkel–Segel, E. L. 07440

Perry, T. G. *See* Bork, Kenneth B. 02243

07401 **Peters, H. R.** Hugh Dalrymple Lilly, 1923–1966—An appreciation, *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 7–8, portrait, 1967.

07411 **Peters, H. R.** Mineral deposits of the Halls Bay area, Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 171–179, illus., 1967.

The sulphide deposits of the Halls Bay area are generally related to strong chloritic shear zones in Ordovician pillow lavas. Field and petrographic evidence indicate that the sulphides are related to periods of volcanic activity and may have been remobilized and concentrated in structural or stratigraphic traps at the time of emplacement of granite or granodiorite bodies. Silurian rocks are more widespread than previously mapped, and probably some rocks originally interpreted as Ordovician are actually of Silurian age. The massive pyrite–chalcopyrite deposits at Pilley's Island are of the stratabound volcanic exhalative types similar in many respects to deposits in Cyprus.—Author's abstract

02288 **Petersen, G. W.; Lee, G. B.; Chesters, G.** A comparison of red clay glacio–lacustrine sediments in northern and eastern Wisconsin: Wisconsin Acad. Sci., Arts and Letters Trans. 1967–68, v. 56, p. 185–196, illus., tables [1968].

Selected red, clayey, glacio–lacustrine sediments from Lake Superior's southern shore and from the Fox and Wolf River drainage basins were compared, and also soils formed from them. Close similarities in particle size distributions of the carbonate–free clay fractions, and in types and amounts of mineral species in each clay fraction, support the theory that the finer fractions of the sediments in both areas were derived from a common source and deposited in a similar manner. The source of the noncarbonate clay fraction is most likely the Lake Superior basin from which fine–grained sediments were discharged into the Michigan basin during

retreat of the Cary ice. Differences between their sand, silt, carbonate, iron oxide, and feldspar contents reflect bedrock and earlier drift. Lower carbonate content may account for deeper leaching and degree of podzolization in northern soils.—GDC

Petit, Richard E. *See* Olsson, Axel A. 02401

07339 **Petsch, Bruno C.** (compiler). Vertical-intensity magnetic map of South Dakota—Ground magnetometer survey: South Dakota Geol. Survey Mineral Resource Inv. Map 4, scale about 1 in. to 12 mi., text, 1967.

Magnetic anomalies of South Dakota are grouped into two orders of magnitude: (1) 22 magnetic highs each with a maximum greater than 1,000γ, and (2) 149 with magnitudes up to 1,000γ. Anomalies below 500γ are generally scattered at random, those above 500γ, which are connected directly as lobes or superimposed on regional highs enclosed by the 500γ contour, are generally more isolated. A table of anomalies with intensity greater than 1,000γ shows intensity, depth to Precambrian, test hole and location (where known), and county. Anomalies in excess of 2,500γ—Stanley, Willowdale, Jamesville, Spink, Langford, Bristol, and Crandall—are presented in detail in the text and figured on inset maps.—MCM

02551 **Pflug, Hans D.** Gesteinbildende Organismen aus dem Molar Tooth Limestone der Beltserie (Praekambrium) [with English summ.]: Palaeontographica, ser. B, v. 121, nos. 4–6, p. 134–141, illus., 1968.

"Molar tooth" structures consist of a lime substance which evidently was precipitated from sea water under the influence of life activity of algae. Specimens from the Clarks Fork quadrangle, Idaho–Montana, are described. The "molar teeth" and enclosing limestone contain structured organic remains, and in the peripheries of the "molar teeth" structures are preserved which show the original shape of the algal colonies. X-ray analyses show that the "teeth" are composed of pure $CaCO_3$ whereas the matrix is composed of fine-grained, argillaceous, partly iron-stained detritus. Some of the "teeth" are partly silicified. Albite, along the margins of the "teeth", is syngenetic, probably from the sea water.—*from* Author's summary

02390 **Phelps, E. R.** Correlation of development data and preliminary evaluation, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 122–137, illus., table, 1968.

The use of general area and mine maps, and detailed mine maps and cross sections in estimation and evaluation are discussed. The next step is determination of the most acceptable and economic mining plan, which involves evaluation of ore processing, transportation, market, labor, weather, reclamation, and stream and air pollution. The use of computers in evaluating the many choices is reviewed. An example of a pro forma income estimate is given.—ESL

02603 **Philpotts, John A.; Schnetzler, C. C.** Europium anomalies and the genesis of basalt: Chem. Geology, v. 3, no. 1, p. 5–13, illus., 1968.

Rare-earth abundance data for mafic and plagioclase phenocrysts and their igneous matrix materials indicate that Eu anomalies, while caused by the relative stability of divalent Eu, are controlled largely by crystal-chemistry rather than by the redox conditions in the melt. Eu anomalies in plagioclases and pyroxene fractions from the Juvinas achondrite and a Palisade sill diabase are interpreted in terms of closed-system competition. Eu anomalies in minerals from the southern California batholith are interpreted in terms of Eu depletions in the melts owing to the crystallization of feldspar. The lack of Eu anomalies in most basalts suggests that they probably have crystallized much less than about 18 percent plagioclase prior to extrusion.—Authors' abstract

Phinney, W. C. *See* Griffin, W. L. 02440

Picard, M. Dane. *See* McCormick, C. D. 02487

02522 **Piwinskii, A. J.** Studies of batholithic feldspars—Sierra Nevada, California: Contr. Mineralogy and Petrology, v. 17, no. 3, p. 204–223, illus., tables, 1968.

Coexisting plagioclase and alkali feldspars and plagioclases of the mafic inclusions have been analyzed using an electron microprobe. Each Sierran rock type contains coexisting feldspar pairs within specific compositional ranges. Core plagioclase compositions of mafic inclusions are only slightly higher or lower in anorthite than host rock plagioclases and cluster between An30 and An40. Chemical inhomogeneity of Sierran potash feldspars and this effect on the Barth *k* value prohibits use of the feldspars as geothermometers for these particular rocks. Results of electron microprobe, X-ray, and petrographic study and experimental hydrothermal investigation of the "granites" suggest, but do not prove, that both plagioclase composition and mafic inclusion mineralogy can be explained in terms of a model which considers inclusions to be refractory residue left over from partial melting of crustal material.—*from* Author's abstract

02188 **Pohl, E. Robert; Browne, Ruth G.; Chaplin, James R.** Foraminifera of the Fraileys Member (Upper Mississippian) of central Kentucky: Jour. Paleontology, v. 42, no. 2, p. 581–582, 1968.

A foraminiferal faunule of remarkable variety, yielding about 4,000 specimens from 16 families and 37 genera, was found. Some genera are new to the Mississippian and some are new to North America. The publication of several manuscripts, each devoted to taxonomically allied forms, is planned.—JFM

02195 **Pollock, C. A.** Lower Upper Devonian conodonts from Alberta, Canada: Jour. Paleontology, v. 42, no. 2, p. 415–443, illus., table, 1968.

Conodonts from two outcrop sections in the Rocky Mountains and seven cored well sections from the central Alberta plains establish the presence of six Upper Devonian conodont zones described by Willi Ziegler in 1962. These zones, comprising the major portion of the *Manticoceras* Zone of the German standard ammonoid section, are the lower, middle, and upper *Polygnathus asymmetricus* Zones, the *Ancyrognathus triangularis* Zone, and the lower and upper *Palmatolepsis gigas* zones.—*from* Author's abstract

07413 **Poole, W. H.** Tectonic evolution of Appalachian region of Canada [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 9–51, illus., 1967.

The Appalachian geosyncline, on the southeast margin of the St. Lawrence Platform, had a complex interplay of Paleozoic sedimentation and tectonism. Hadrynian volcanic-bearing strata in the Avalon platform separated the Acadian and Meguma geosynclines in Cambrian to Devonian time. Taconian orogeny resulted in ultramafic intrusion; local folding, metamorphism, and granitic intrusion; rise of geanticlinal belts; and two westward moving klippen. During Acadian orogeny the entire region was deformed, intruded by granite, uplifted, and eroded. Devonian–Permian continental deposits, interrupted by Mississippian limestones and Pennsylvanian coal, are thickest in the Fundy geosyncline, faulted by the Maritime disturbance into troughs, basins, and uplifted blocks. On the southern edge, there followed Triassic redbeds and basalt, erosion, intrusion of stocks, and continental-shelf deposition.—GDC

02410 **Potter, R. R.; Jackson, E. V.; Davies, J. L.** Geological map, New Brunswick: New Brunswick Dept. Nat. Resources Map N.R.-1, scale 1:500,000, 1968.

02549 **Prakash, U.** Miocene fossil woods from the Columbia basalts of central Washington, [Pt.] 3: Palaeontographica, ser. B, v. 122, nos. 4–6, p. 183–200, illus., tables, 1968.

In the present paper the author is concerned with the identification and description of six species representing four genera not described in previous papers dealing with this flora from the Vantage area. These are *Betula, Robinia, Pseudotsuga* or *Picea*, and *Taxodium* or *Sequoia*. Beck (1945, 1955, 1956) listed 29 genera from Vantage, of which 26 were definitely determinable and three uncertainly determined. The

fossil woods described herein are well preserved and in most cases show fine structural details of minute anatomy.—*from* Author's introduction

Pratt, P. F. *See* Bair, F. L. 02255

07528 **Preiss, Kenneth.** Nondestructive measurement of the water content and bulk density of sediment using radioisotopes, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 307–318, illus., tables, 1967.

The paper reviews non-destructive methods of measuring bulk density and water content using radioisotopes. Information is presented about sources and detectors of radiation, about health hazards, and about the interactions of gamma rays and neutrons with atoms of sediment. The methods of bulk density measurement by gamma ray transmission and scattering, and water content measurement by neutron scattering, are described. Consideration is given to errors in a reading due to inaccurate calibration, to the chemical composition of the sediment, to electronic instability and to the statistics of nuclear decay.—Author's abstract

02371 **Pressman, Albert E.** Geologic comparison of Ektachrome and infrared Ektachrome photography, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 396–397, illus., 1968.

In photographs taken at altitudes of 10,000 to 30,000 feet, color contrast for differentiating surface materials is often lost by hazy conditions, the attenuation of light being more on the blue than red end of the spectrum. Magnified with increasing altitude, haze can be filtered, but significant advantages are gained by use of the longer wavelength sensitive film, Infrared Ektachrome, as compared with Ektachrome in illustrations. Exposed simultaneously on a normal day, the films at 2,500 feet have similar color saturation and geologic detail; at 11,000 feet, the infrared pair is superior for geologic mapping, formations easily subdivided on the basis of color.—GDC

02378 **Pryor, William T.** Photographic interpretation for highway engineering, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 402–403, illus., 1968.

The usual gray shades of panchromatic photography are very limited in comparison to the thousands of hues within the range of visible colors. In highway engineering, color photographs fulfill dual needs, supplying qualitative information by interpretation, and quantitative data by photogrammetry. On the illustrative stereogram of a massive landslide crossed by the highway over McClure Pass in Colorado, significant details of engineering interest are designated by letter. Interpreted features are: predominantly detrital material derived from poorly consolidated sandstones and shales; an old landslide well covered by vegetation; signs of land use; minor active slides; erosive action; and Muddy Creek confined to a narrow channel by the larger slide.—GDC

02497 **Quinn, James H.** The Atoka problem [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 117–118, 1968.

07496 **Radinsky, Leonard B.** *Hyrachyus, Chasmotherium*, and the early evolution of Helaletid tapiroids: Am. Mus. Novitates, no. 2313, 23 p., illus., tables, 1967.

The rhinocerotoid family Hyrachyidae, which in its last review (Wood, 1934) included 4 genera and 12 species, is reduced to a subfamily, with one genus and three species, and included in the tapiroid family Helaletidae. Because the European genus *Chasmotherium* can be traced back to *Hyrachyus*, the monotypic subfamily Chasmotheriinae is transferred to the Helaletidae. A taxonomic revision of species of *Hyrachyus* from the Bridger Formation, Wyoming, is presented.—KAF

Rapp, G., Jr. *See* Davis, B. L. 02447

Rausch, Donald O. *See* Merrill, Robert H. 02391

02300 **Rea, Dixon; Bouwkamp, Jack G.** A source of damping produced by the interaction of close-standing buildings: Seismol. Soc. America Bull., v. 58, no. 3, p. 917–935, illus., tables, 1968.

A multistory steel-framed building was subjected to dynamic tests at various stages of construction. In the interval between two series a dramatic increase in damping occurred which is attributed to interaction of the building with its service tower. The second test series was conducted after the service tower was structurally complete. The two buildings were dynamically coupled, with connections only at the basement and foundation levels. Nonstructural connections at every floor level dissipated energy in relative motion between the buildings. From experimental data it was possible to estimate the amount of energy this source of Coulomb damping could dissipate and to show that it was responsible for the large changes noted in damping capacity.—DBV

07334 **Read, William F.** Jenkins—A new iron meteorite from Missouri: Meteoritics, v. 3, no. 3, p. 141–146, illus., 1967.

Jenkins was found about 1946 [Barry County, Missouri] and identified as a meteorite in 1965. The weight before sectioning was 122 lbs. It is a coarse octahedrite with irregular nodules of troilite and sizeable patches of graphite, schreibersite, and lawrencite.—Author's abstract

02324 **Reed, Eugene C.** Loess deposition in Nebraska, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 23–28, 1968.

On the basis of loess deposits of Nebraska and adjoining areas, it is concluded that loess is eolian in origin and does not include similarly textured deposits of noneolian origin. Multiple sources of loess exist in this region—glacial outwash, and the Sand Hills of north-central Nebraska are important sources. Little or no evidence exists to support the premise that significant deposits accumulated by being blown from high surfaces to accumulate upon lower nearby surfaces; nor is there physical evidence that loess accumulated under extremely dry or desert conditions. An alternative set of conditions is postulated for development of loess deposits in this area.—MST

07406 **Reed, Philip C.; Newton, John G.; Scott, John C.** Geologic map of Butler County, Alabama: Alabama Geol. Survey Map 56, scale about 1 in. to 1 mi, text, 1967.

Geologic units in Butler County from oldest to youngest are: Cretaceous Ripley Formation and Providence Sand; Tertiary Clayton, Porters Creek, Naheola, and Nanafalia Formations, Tuscahoma Sand, and Hatchetigbee, Tallahatta, and Lisbon Formations; and Quaternary terrace and alluvial deposits. All outcrop units are sources of ground water; supplies of 0.5 mgd or more per well are available from sand, gravel, and porous limestone in the Ripley, Clayton, and Nanafalia Formations. Brown iron ore is mined from the top of the Clayton and from the upper half of the Porters Creek in the eastern section. The Clayton contains limestone high in calcium carbonate content; sand occurs in most Tertiary formations, and lignitic sand and clay and some thin laminae of lignite are present in parts of the Tuscahoma Sand.—MCM

07424 **Reed, Robert C.** Copper mineralization in Animikie sediments of the eastern Marquette Range, Marquette County, Michigan: Compass, v. 45, no. 1, p. 47–55, illus., 1967.

Copper mineralization is known from four areas within Animikie sediments of the eastern part of the Marquette syncline. The copper minerals consist of chalcocite, chalcopyrite, bornite, covellite, and the native metal. Specular hematite, earthy hematite, pyrite, limonite, sericite, and chlorite are abundant. Silicification is widespread. Minor trace elements are restricted to titanium, manganese, and locally barium and strontium. The metallic and gangue minerals associated with this mineralization are strikingly similar to copper sulphides and associated minerals in Keweenawan rocks surrounding Lake Superior.—Author's abstract

02561 **Reed, T. E.; McMurtrey, R. G.** Water levels and artesian pressures in observation wells in Montana through 1967: Montana Bur. Mines and Geology Bull. 65, 40 p., illus., tables, 1968.

Ground water in Montana occurs under a wide range of conditions and in varying degrees of usefulness. Water-level fluctuations generally are cyclical, reflecting seasonal changes in the amount of water in storage. The systematic collection of data on ground-water levels in Montana was begun in 1947 under a nationwide observation program. It was made part of a cooperative ground-water program in 1965 when state funds were made available to expand the network. This is the second in a series of annual reports of water-level records for all permanent observation wells in Montana. It includes all data published in the first report of this series and data for 38 additional wells. Each fifth year will be a compilation of the previous five years.—GDC

02236 **Rehm, G. W.; Caldwell, A. C.** Sulfur supplying capacity of soils and the relationships to soil type: Soil Sci., v. 105, no. 5, p. 355–361, 1968.

A study was made of the sulfur supplying capacity of 79 Minnesota soils. It was found that the soils from the north-central and northeastern regions of the state have a low sulfur supplying capacity. Soils in the southern and western regions were found to have a high sulfur supplying capacity. The authors conclude that $NaHCO_3$, $NH_4C_2H_3O_2$, and $C(H_2PO_4)_2$ extractable sulfur are satisfactory estimates of available sulfur.—JWH

07437 **Remo, John.** A physical model for the terrestrial origin of tektites [abs.]: Meteoritics, v. 3, no. 3, p. 122, 1967.

07474 **Rhodes, J. R.** Optimization of excitation and detection techniques for analysis of silver ores by radioisotope X-ray spectrometry, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 442–464, illus., table, 1967.

A method for X-ray fluorescence analysis of silver in ores, in which AgK X-rays are excited by a radioisotope source-target assembly emitting spectrally pure I K X-rays uses as a detector a cooled, lithium-drifted silicon diode with a low noise preamplifier employing a cooled, field-effect transistor. The detection system has a resolution for AgKα X-rays of 580 eV (f.w.h.m.). With this optimized excitation and detection technique, detection limit for silver in ores was 22 ppm in a count time of 4 min with a primary source activity of 14 mC. Tests on 15 analyzed natural ore samples showed severe matrix effects when AgKα flux was plotted as a function of silver content. When the ratio AgKα to Compton-scattered I Kα flux was used, correlation with silver content improved so that all but three ores fell on the same calibration curve.—*from* Author's abstract

Ribbe, Paul H. *See* Colville, Alan A. 02208

02266 **Rice, H. B.; Kamprath, E. J.** Availability of exchangeable and nonexchangeable Mg in sandy coastal plain soils: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 386–388, illus., tables, 1968.

The chemical forms of Mg in five sandy coastal plain soils were determined. The total Mg ranged from 0.73 meq to 2.48 meq/100g. The percentage of the total Mg in the exchangeable form varied from 3.8 to 9.4 percent and generally increased as the total increased. Soils containing an expansible lattice clay had the highest Mg content per gram. Extractions indicate that a portion of the nonexchangeable Mg is quite soluble in dilute acid. The soils which released the highest amount of nonexchangeable Mg per gram of clay also were the ones containing some expansible clay minerals. The exchangeable Mg in the range 0.05 to 0.23 meq/100g of soil appeared to be equally available as indicated by plant uptake.—*from* Authors' abstract

07393 **Richards, Adrian F.; Hamilton, Edwin L.** Investigations of deep-sea sediment cores—[Pt.] 3, Consolidation, *in* Marine geotechnique—Internat. Research Conf.,

Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 93–117, illus., 1967.

Results of laboratory consolidation tests on 10 cores from the Atlantic and Mediterranean and 2 from the Pacific are presented as graphs of void ratio, e, relative to the logarithm of pressure, p, and the coefficient of consolidation, c_v. Sedimentation compression e–log p curves were graphed also. At the same void ratio the preconsolidation pressure estimated from the laboratory-consolidated samples was higher than the measured effective overburden pressure determined from the sedimentation compression curves. At depths 0.5–1 m below sea bottom all cores exhibited apparent overconsolidation. With increasing depth below bottom there is less consolidation, resulting in less reduction of porosity than expected. It is postulated that the unusually strong sedimentary structure represented by the condition of apparent overconsolidation is caused by a chemical cement-like, intergrain bonding, although actual cementation is not visible.—*from* Authors' abstract

07515 **Richards, Adrian F.** (editor). Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, 327 p., illus., tables, 1967.

This book contains most of the papers presented at the 1966 Conference on Marine Geotechnique. Papers are presented in each of the following areas: (1) laboratory results and areal investigations; (2) submarine slides, slumps and slope stability; (3) sampling and in-place measurements; and (4) nondestructive testing and literature survey.—KAS

07529 **Richards, Adrian F.** Basic literature of marine geotechnique and related fields, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 319–323, 1967.

A short, selected list of sources of published information covering the fields of marine geotechnique, marine geology, ocean engineering, and soil mechanics are given that may be of use to persons considering marine geotechnical investigations.—Author's abstract

Richardson, A. M., Jr. *See* Harrison, W. 07526

02442 **Richardson, S. W.; Bell, P. M.; Gilbert, M. C.** Kyanite-sillimanite equilibrium between 700° and 1500°C: Am. Jour. Sci., v. 266, no. 7, p. 515–541, illus., tables, 1968.

Gas medium and solid medium pressure apparatus were used. The lower temperature experiments were done hydrothermally. Only great changes, about 20 percent conversion of one polymorph to another, were accepted as diagnostic. The preferred equation expressing equilibrium results is $P(kb) = 0.0243T(°C) - 9.63$. Maximum uncertainties in metamorphic ranges are included. The presence of water has no effect on the position of the transition, although it speeds attainment of equilibrium. Geological applications of the results to the problems of load pressure in metamorphism can be made in areas where the temperature of the kyanite sillimanite isograd is determined independently.—*from* Authors' abstract

02554 **Ridge, John Drew.** Comments on the development of the ore-bearing structures of the Mascot-Jefferson City district and on the genesis of the ores contained in them: Inst. Mining and Metallurgy Trans., Sec. B, v. 77, Bull. 735, p. B6–B17, illus., 1968.

It has been suggested that the zinc deposits were emplaced during the Middle Ordovician in solution breccias developed during an erosion interval. The volumes of breccia could have served as channelways for the ore-forming fluids any time between Middle Ordovician and late Paleozoic. The youngest late Paleozoic faults have cut sphalerite putting an upper limit on its deposition. The writer believes that bedding in many of the dolomite sand pockets containing sphalerite is horizontal, at least in the upper part, so that the sand must have been emplaced after the folding. If the sphalerite is detrital, then mineralization preceded sand

deposition; if it has replaced dolomite, as seems more probable, then mineralization is later than the sand. The age of mineralization is probably between the folding and large-scale thrusting. Deposits are thought to have formed in the telethermal range.—*from* Author's abstract

07434 **Rigby, J. Keith.; Hintze, Lehi F.** Exit-Entrance road log—Salt Lake City to Moab, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 129-149, illus., 1967.

The route is 233 miles in length. Descriptions of the geology to be seen along the way is given at certain clearly identifiable locations.—HRC

Rigby, J. Keith. *See* Utah Geological Society. 07456

02541 **Rigsby, George P.** The complexities of the three-dimensional shape of individual crystals in glacier ice [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 233-251, illus., tables, 1968.

A block of ice from Blue Glacier, Washington, was successively sectioned at close intervals to determine exact crystal shape in three dimensions. Two crystals occupying over 20 percent of the entire sample are used as examples, and their volumes calculated. These crystals were found to be much larger and more complex in shape than expected from thin-section examination alone. The surface-to-volume ratio was calculated using a simple relation between length of lines in a grid crossing the crystal and grid-line intercepts with the crystal boundary; from this the surface area of each crystal was calculated. A measurement of irregularity is introduced to compare crystals of different size with one another. This is necessary because surface-to-volume ratio of a body of the same shape decreases as the size increases.—*from* Author's abstract

02233 **Riley, John F.** The cobaltiferous pyrite series: Am. Mineralogist, v. 53, nos. 1-2, p. 293-295, illus., 1968.

Natural samples of cobaltiferous pyrite were analyzed for their iron and cobalt content. Compositions from nearly pure iron disulfide (pyrite) to greater than 75 wt. percent cobalt disulfide (cattierite) were found. Experimental results show a solvus in the binary below 700°C, but natural samples do not reflect this observation. The X-ray spacing, d(511), is shown to be linear with composition.—JLH

Riley, Leonard B. *See* Haffty, Joseph. 02278

Roberts, John F. *See* Jordan, Louise. 07491

Roberts, K. F. *See* Gardner, R. P. 07345

02480 **Roberts, Ralph J.** Tectonic framework of the Great Basin, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt-Geology Dept. Colloquium Ser. 1), p. 101-119, illus., 1968.

The Precambrian framework is not well known, though certain trends are recognized. Lower Paleozoic sedimentation in the Cordilleran orthogeosyncline was characterized by eugeosynclinal sediments to the west and miogeosynclinal sediments to the east. In Late Devonian time the Antler orogeny occurred, primarily vertical uplift, between the two zones. Two post-Antler troughs developed where thick orogenic sediments accumulated. During the late Mesozoic these two belts, the Nevadan and Sevier, were uplifted and poured sediments eastward and westward. About five miles of material was unloaded, and great crustal imbalance resulted so that in the source area crustal break-up, possibly accentuated by magmatism, resulted in Basin and Range structure.—*from* Author's abstract

07531 **Robertson, Eugene C.** Laboratory consolidation of carbonate sediment, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 118-127, illus., table, 1967.

Aragonite sediment from the Bahama Banks was subjected to pressures from 10^{-3}–10^{+4} bars. Above 10 bars, the pressure required for unit compaction increases exponentially; below 10 bars the pressure required is much less. Permeability of silt and clay-sized sediment ranges from 10^{-6} to 1 darcy, with porosity proportional to log permeability. The conditions affecting the maximum compaction are rate of loading, initial water content, grain size and shape, and friction. The parameter, solid grain proportion, equal to one minus the porosity, is proposed as a useful compaction index because it is a normalized density, equal to the ratio of dry bulk density to solid grain density.—Author's abstract

02434 **Robie, Richard A.; Waldbaum, David R.** Thermodynamic properties of minerals and related substances at 298.15°K (25.0°C) and one atmosphere (1.013 bars) pressure and at higher temperatures: U.S. Geol. Survey Bull. 1259, 256 p., tables, 1968.

Critically selected values for the entropy, molar volume, and for the heat and Gibbs free energy of formation are given for 50 reference elements and 285 minerals and related substances. For 211 materials for which high-temperature heat-capacity or heat-content data are available, thermodynamic properties are tabulated at 100°K intervals for temperatures up to 2,000°K. For substances having solid-state phase changes or whose melting or boiling point is less than 2,000°K, we also have tabulated the properties at the temperature of the phase change so that the heat or entropy changes associated with the transformation form an integral part of the high-temperature tables.—*from* Authors' abstract

07486 **Robinson, Charles S.; Lee, Fitzhugh T.** Results of geologic research at the Straight Creek Tunnel pilot bore, Colorado: Highway Research Rec., no. 185 (Natl. Acad. Sci.–Natl. Research Council–Natl. Acad. Eng. Pub. 1516), p. 9–19, illus., table, 1967.

Projection of details of surface geology to depth before construction has met with only limited success in many tunneling operations. In this research project, good results were obtained by prediction, based on a statistical study of surface and drill hole features, of the kinds of conditions and their extent, but not their exact locations, that could be expected at tunnel level. Successful predictions were made regarding percentages of rock types, linear feet of faulted and sheared rock, and attitudes of foliation and fractures, including faults and joints. Predicted rock loads and final swell pressures in gouge and altered rocks agreed well with actual measurements. Ground-water flows occurred in expected amounts, but criteria for estimations proved unsound. Estimates of amount of temporary support, footage of feeler holes, and amount of grouting required provided engineers with a sound basis for estimates of tunnel costs.—*from* Authors' abstract

Roddick, J. A. *See* Green, L. H. 02585

07493 **Roddick, J. A.; Wheeler, J. O.; Gabrielse, H.; Souther, J. G.** Age and nature of the Canadian part of the circum-Pacific orogenic belt, *in* Age and nature of the circum-Pacific orogenesis—Pacific Sci. Congress, 11th, Tokyo, 1966, Symposium: Tectonophysics, v. 4, nos. 4–6, p. 319–337, illus., 1967.

The Canadian Cordilleran orogen evolved from a miogeosyncline which existed from Proterozoic to mid-Jurassic time, and contemporaneous eugeosyncline on the west. History of the eugeosynclinal belt since mid-Palaeozoic, was influenced by the less persistent Coast and Omineca crystalline geanticlines and intervening non-metamorphic Pinchi geanticline. Since mid-Triassic time the crystalline geanticlines have been the principal sites of frequent uplift, recurrent granitic intrusion, metamorphism, and deformation. The crystalline geanticlines were repeatedly deformed but not always synchronously, whereas adjoining troughs were rarely deformed more than once. Orogenic pulses took place at the following times: Proterozoic, early and mid-Palaeozoic, early Middle Triassic, Middle Jurassic, latest Jurassic and earliest Cretaceous, mid-Cretaceous, early and late Tertiary.—*from* Authors' abstract

Roeder, P. *See* Campbell, F. E. 02199

Rogers, John J. W. *See* Mahan, Sheila N. 02210

07387 **Rogers, T. H.; Church, C. C.** Upper Cretaceous[?] rocks southwest of Hollister, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Sec., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 45–47, illus., 1967; correction, ibid., p. 44A, 1967.

Mudstone samples from two localities in a sandstone and mudstone section within a large lens-shaped fault block in the San Andreas zone southwest of Hollister, Calif., contained Upper Cretaceous Foraminifera. The nearest Upper Cretaceous outcrop, five miles away, is not fossiliferous. No Cretaceous appears in well logs in the area. On further study, after the paper was submitted, no more Cretaceous fossils could be found and it is concluded that those found were reworked and occur in younger sediments, possibly Pliocene. It is suggested in the correction that "Upper Cretaceous" in the title and text be deleted or marked with a question mark.—ESL

07469 **Rogers, Thomas H.; Nason, Robert D.** Active faulting in the Hollister area, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 102–104, illus., 1967.

Recent work in the Hollister, Calif., area has brought to light new evidence of modern right lateral slippage on the San Andreas and Calaveras fault zones. The latter has been traced through the city by mapping right lateral bends and offsets in curbs, sidewalks, street slabs, walls, etc. There appears to have been no movement from 1910 to 1929, but slippage rates since 1929 have ranged from 0.3 to 0.7 inch per yr. There is evidence also of movement north of the city. Fault slippage has been found at several localities on the San Andreas near San Juan Bautista, amounting to about one quarter inch a year. It appears that current slippage is transferring from the San Andreas to the Calaveras and Hayward fault zones in the Hollister area.—ESL

02526 **Rogers, W. S.; Spencer, R. S.** The Pleistocene geology of Princess Anne County, Virginia: Southeastern Geology, v. 9, no. 2, p. 101–114, illus., tables, 1968.

Subsurface studies of the Pleistocene Nansemond Formation reveal numerous complex lithofacies changes due to development of the prograding offshore Princess Anne bar-scarp as well as development of secondary bar deposits within the lagoon behind the bar-scarp. Three well-defined sand and gravel aquifers which appear to coalesce in the subsurface extension of the off-shore bar transect the remaining lagoonal lithofacies. A synthesis of the literature and examination of well logs suggest the presence of a northwest-southeast trending hinge line marking the western edge of a probable Triassic basin beneath the Coastal Plain of southeastern Virginia and possibly underlying Chesapeake Bay. Periodic movements within the basin are suggested as the cause for the unusually thick Pleistocene deposits in the county. Studies of well log data have resulted in the first piezometric map of the area.—*from* Authors' abstract

07524 **Rosfelder, Andre M.; Marshall, Neil F.** Obtaining large, undisturbed, and orientated samples in deep water, *in* Marine geotechnique—Internat. Research Conf., Monticello, Ill., 1966, Proc.: Urbana, Ill., Univ. Illinois Press, p. 243–263, illus., table, 1967.

A multiplicity of causes of sample disturbance during coring, retrieving, and handling hinders obtaining true undisturbed cores in deep water. However, most of these causes can be reduced in such a way that, for specific analytic purposes, a well-preserved sample can be obtained and considered as satisfactorily "undisturbed." Recent trends in sedimentological and geotechnical procedures result in marine corers with larger diameter and with sample orientation. Attempts were made in improving and modifying several devices for taking large, well preserved, and oriented cores in deep water. These developments, trials, and tests at sea led to the design of modified and improved coring assemblies and also to some new conceptual designs which are presented here.—Authors' abstract

Ross, R. J., Jr. *See* Hobbs, S. W. 02246

02252 **Ross, William D.; Sievers, Robert E.** Rapid ultra-trace determination of beryllium by gas chromatography [with French and German abs.]: Talanta, v. 15, no. 1, p. 87–94, illus., tables, 1968.

The electron capture detector has been used to measure ultra-trace quantities of beryllium separated as beryllium(II) trifluoroacetylacetonate by gas chromatographic techniques. The lower limit of detectability is circa 4×10^{-13}g of beryllium. Samples of beryllium in aqueous solution at four concentrations were analysed quantitatively by combining solvent extraction and gas chromatography. The distribution of beryllium during the extraction procedures was determined independently by use of radioactive beryllium-7, but the use of tracers is not required in the recommended procedure. Interference studies were made on cations and anions found in biological samples. At the concentrations used in the extraction procedure and the gas chromatographic process, none of the 15 ions studied interferes appreciably.—*from* Authors' abstract

Rubin, Meyer. *See* Black, Robert F. 02282

02326 **Ruhe, Robert V.** Identification of paleosols in loess deposits in the United States, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 49–65, illus., tables, 1968.

Quantitative data of paleosols of the central United States and their relation to the physiographic history within the Pleistocene are examined. Problems discussed in detail include: paleosol stratigraphy of the Sangamon Soil on Loveland (Illinoian) Loess, the Farmdale Paleosol that is usually found at the base of the Wisconsin loess, and the Brady buried soil within the Wisconsin loess.—MST

Rukavina, N. A. *See* Woodrow, D. L. 07367

07365 **Rukavina, Norman A.** Rapid inspection of soft sediment cores by X-radiography *in* Conf. on Great Lakes Research, 10th, Toronto, Ontario, 1967, Proc.: Ann Arbor, Mich., Internat. Assoc. Great Lakes Research, p. 143–148, illus., 1967.

X-radiography provides a fast and non-destructive method for the preliminary inspection of unconsolidated sediment cores. Test radiographs of several cores from Lake Ontario indicate that adequate definition of sedimentary structure is obtained when cores are radiographed in their plastic liners. This approach permits soft sediment structure to be recorded before it is distorted or destroyed by extrusion and eliminates the conventional sample preparation for radiography. Preliminary results of a comparison of radiograph density with sediment parameters indicate that density is a function of water content (porosity), which is in turn related to particle size, organic content, and consistency.—Author's abstract

02275 **Ruppel, Edward T.** Geologic map of the Leadore quadrangle, Lemhi County, Idaho: U.S. Geol. Survey Geol. Quad. Map GQ-733, scale 1:62,500, sections, separate text, 1968.

The separate text contains descriptions of the rock units.—MCM

Rush, F. Eugene. *See* Glancy, Patrick A. 02576

02484 **Russell, John L.** Clay minerals from solution cavities in Permian rocks near Manhattan, Kansas [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 21, 1968.

Rust, R. H. *See* Foss, J. E. 02267

02360 **Ryall, Alan; Bennett, Dale L.** Crustal structure of southern Hawaii related to volcanic processes in the upper mantle: Jour. Geophys. Research, v. 73, no. 14, p. 4561–4582, illus., table, 1968.

On the basis of a seismic refraction profile on the Island of Hawaii from Hilo to Kalae, the Earth's crust in the vicinity of Kilauea Volcano has three layers. The uppermost layer varies in thickness from 1.2 to 2.5 km along the profile, is characterized by a P-wave velocity of about 3 kmps, and probably represents a series of fractured vesicular lava flows. The second layer, with a velocity of 5.3 kmps, is much less even in thickness and probably represents the principal volcanic layer of the crust. The third layer is 6–7 km thick, has a P-wave velocity of about 7 kmps, and corresponds to the principal layer of the oceanic crust. Comparison of seismic results indicates that the main rift zones of Mauna Loa and Kilauea are north-dipping transcrustal fracture zones. Although most of the island is subsiding, the southeastern flank is being inflated by magmatic intrusions.—*from* Authors' abstract

Sadlick, Walter. *See* Nitecki, Matthew, H. 02193

07438 **Salisbury, Winfield W.** Experimental test of chondrule formation [abs.]: Meteoritics, v. 3, no. 3, p. 123, 1967.

Sandberg, H. J. *See* Bradley, C. L. 07450

Sanderson, D. *See* Oray, E. 07417

SanMiguel, A. *See* Amoros, J. L. 02271

02353 **Santhanam, A. T.; Gupta, Y. P.** Cleavage surface energy of calcite: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 3, p. 253–259, illus., 1968.

The microscopic mechanisms of rock failure are important in development of methods of mining and of petroleum exploration by drilling. One method of evaluating the dissipation process in rock fracture is to determine experimentally the cleavage surface energies of various minerals in a rock. In this study, the surface energy of the cleavage planes [1011] of calcite crystals was determined at 298°K by a modified Gilman cleavage technique. A value of 347±45 ergs per cm^2 is obtained for the true surface energy, evaluated from measurements of the newly defined 'Modified Apparent Inverse Surface Energy' as a function of the initial crack length and specimen dimensions. Good agreement between experimental and theoretical values indicates absence of appreciable plastic deformation at the crack tip and that, at room temperatures, calcite deforms by brittle fracture.—VSN

07359 **Santo, Tetsuo.** Lateral variation of Rayleigh wave dispersion character—Pt. 4, The Gulf of Mexico and Caribbean Sea [with Japanese abs.]: Tokyo Univ. Earthquake Research Inst. Bull., v. 45, pt. 4, p. 963–971, illus., tables, 1967.

Regionalization of a certain area into several dispersion regions was performed for the Gulf of Mexico, Caribbean Sea and their surroundings. An interesting phenomenon was that a small area with such dispersion indexes of larger than *10* were revealed off the coast of Texas in the western part of the Gulf of Mexico. This result is identified with the existence of a region having extremely thick sediments.—Author's abstract

02505 **Saucier, Roger T.** A new chronology for braided stream surface formation in the lower Mississippi Valley: Southeastern Geology, v. 9, no. 2, p. 65–76, illus., 1968.

Existing late Quaternary chronology for the Lower Mississippi Valley indicates widespread braided-stream surfaces were formed during waning stages of Late Wisconsin glaciation and mark the end of an alluviation period that preceded development of modern meanders. Recent stratigraphic investigations suggest that some surfaces were affected by a period of waxing glaciation following their formation. This evidence and two radiocarbon dates indicating a 29,000- to 31,000-year age for one valley surface, necessitates a new chronology for valley events. The proposed chronology attempts to show a correlation between valley events and concepts of late Quaternary sea-level variations. Certain braided-stream surfaces were formed 25,000 to 30,000 yr ago during or shortly preceding a high sea-level stand corresponding to the Farmdalian Substage while others postdate the

subsequent and latest period of low sea level stand 18,000 to 20,000 yr ago.—*from* Author's abstract

Schaeffer, O. A. *See* Kirsten, T. 07327

Schaeffer, O. A. *See* Thompson, S. O. 07442

07459 **Schenk, Paul E.** The significance of algal stromatolites to paleoenvironmental and chronostratigraphic interpretations of the Windsorian Stage (Mississippian), Maritime Provinces [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 229–243, illus., table, 1967.

Thick, mainly continental, Carboniferous sediments accumulated in a complex rift-valley system following late Devonian orogeny. The first marine transgression was a widespread carbonate unit called the Macumber Formation, with two distinct lithosomes similar to Recent strandline deposits: a thickly laminated, sparsely fossiliferous, cross-stratified, pelleted limestone, and a thinly laminated, dolomitic, brecciated algal stromatolite. The Windsorian Stage began with local faulting, causing rejuvenation of upland stream areas, deposition of marginal fanglomerate, and sudden marine transgression. The Macumber offlap lithosomes record slow regression, illustrated in a generalized facies pattern by a landward-thinning wedge; locally modified, the progression is from shelf biosparite to lagoonal pelmicrite, to supratidal gypsiferous marl, and red alluvial fans.—GDC

07499 **Schieber, Michael M.** Experimental magnetochemistry—Nonmetallic magnetic materials, V. 8 *in* Series of Monographs in Solid State Physics (E. P. Wohlfarth, editor): Amsterdam, North-Holland Publishing Co.; New York, John Wiley and Sons, 572 p., illus., tables, 1967.

Following a brief history of discoveries and contributions to the study of magnetism, this book is subdivided into seven chapters: summary of principles; materials preparation; methods of measurements and characterization of magnetic compounds; magnetic oxides with Fe^3 as the chief constituent; magnetic oxides of the transitional elements where Fe^3 is not the chief constituent; rare earth oxides and their compounds having perovskite, garnet, or other structures; and monoxides of transition and rare earth elements. Appendices include the following subjects: definition and conversion of magnetic units, exercises in magnetic materials as problems for students, and calculation of a magnetic susceptibility in a cubic crystal field.—GDC

Schiemer, E. W. *See* Schubel, J. R. 07513

02351 **Schlanker, C. M.; Leisman, G. A.** The herbaceous Carboniferous lycopod *Selaginella fraiponti* comb. nov. [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 724, 1968.

02375 **Schneider, William J.; Kolipinski, Milton C.** Water resources, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 418–419, illus., 1968.

Interpreting hydrologic conditions by color aerial photography is illustrated in an area of the Florida Everglades 40 miles west of Miami. A new highway serves as a conservation control levee, north of which the area is inundated. Average ground surface is about eight feet above sea level; local relief is about two feet; natural water-level fluctuations range up to three feet annually. Minor differences in land-surface elevation can be inferred from particular plant communities and shallow ponds. Orientation of tree islands indicates persistent direction of flow from north to south. An open ring of trees identifies a hole dug by an alligator to establish year-round aquatic conditions. Various signs of man's activities are noted.—GDC

02439 **Schneider, William J.** (compiler). Water data for metropolitan areas—A summary of data from 222 areas in the United States: U.S. Geol. Survey Water-Supply Paper 1871, 397 p., illus., tables, 1968.

Adequate hydrologic data are prerequisite to proper planning and engineering design of urban environments. Some such data are available and are tabulated for each Standard Metropolitan Statistical Area in the United States. Information for each area consists of (1) data on size and population, (2) a short statement of the hydrology, (3) a summary of current data-collection activities, (4) a listing of current U.S. Geological Survey investigational projects, and (5) a short listing of reports relating to the hydrology.—*from* Author's abstract

Schnetzler, C. C. *See* Philpotts, John A. 02603

02284 **Scholl, D. W.; Hopkins, David M.; Buffington, E. C.; Greene, H. G.** New petroleum prospects, shallow and deep Bering Sea [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 56 [1968].

02298 **Scholz, C. H.** Microfractures, aftershocks, and seismicity: Seismol. Soc. America Bull., v. 58, no. 3, p. 1117–1130, illus., 1968.

Laboratory investigation of microfracturing in brittle rock has revealed that microfracturing events can be detected after brittle fracture of rock in compression, provided the specimen remains intact. If the sample is isolated after fracture, microfracturing activity decays hyperbolically in a manner similar to typical earthquake aftershock sequences. If reloaded, the sequence is disturbed and a cumulative aftershock pattern develops similar to that described by Benioff as strain release due to shear creep. These two types of sequences are discussed with respect to a Markovian model of time dependent fracture in an inhomogeneous brittle medium. This model is then expanded to apply to earthquake aftershock sequences. According to this theory aftershocks are produced by creep rupture due to stress corrosion in the regions of stress concentration following the main shock.—*from* Author's abstract

02305 **Schopf, J. M.** Reinterpretation of the glossopterid sporophyll [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 726, 1968.

07501 **Schopf, Thomas J. M.** Names of phyla—Ectoprocta and Entoprocta, and Bryozoa: Systematic Zoology, v. 16, no. 3, p. 276–278, 1967.

Schopf points out that one of the major coelomate groups, Ectoprocta, with approximately 3,500 species (including many extinct taxa), is unfortunately included with the very different Entoprocta, a pseudocoelomate group of about 100 extant (nonfossil) species, under Phylum Bryozoa—a term that is also applied to the ectoprocts alone. To avoid confusion from this dual use, Schopf suggests that those who consider ectoprocts and entoprocts as distinct phyla should refer to them as Phylum Ectoprocta and Phylum Entoprocta; Bryozoa may be retained in its historical sense to include both, but definitely should not be used as a synonym of Phylum Ectoprocta.—VMJ

07513 **Schubel, J. R.; Schiemer, E. W.** A semiautomatic microscopic particle size analyzer utilizing the Vickers image splitting eyepiece: Sedimentology, v. 9, no. 4, p. 319–326, illus., 1967.

Microscopic size analysis is the most direct of all size analysis procedures and is frequently used as a calibration technique for other methods. The commonly used microscopic procedures, however, are laborious and the results are frequently inaccurate because of the small number of particles measured by most investigators. Using the Vickers Eyepiece, we have built an inexpensive (<1,000 dollars), semiautomatic microscopic size analyzer with which particles are sized, sorted into sixteen classes, and counted, accurately and quickly. The instrument combines direct observation with speed, accuracy, and ease of measurement to make it a valuable tool for the size analysis of a wide range of materials.—Authors' summary

02329 **Schultz, C. Bertrand.** The stratigraphic distribution of vertebrate fossils in Quaternary eolian deposits in the midcontinent region of North America, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 115–138, illus., 1968.

The central Great Plains and adjacent areas are ideal places for the establishment of a faunal sequence of the Quaternary, because the area is adjacent to the extensive continental glaciated region, and also contains large areas of periglacial deposits. Intertill deposits, as well as adjacent periglacial sediments are highly fossiliferous. Paleontologists have established an accurate faunal sequence for the region, and stratigraphic correlations have been extended outward from the glaciated areas. The larger mammalian fossils provide splendid evidence of regional Quaternary changes in climate and associated animal migration, as they are not as easily adaptable to climatic changes as smaller forms.—MST

02339 **Schultz, C. Bertrand; Frye, John C.** (editors). Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, 369 p., illus., tables, 1968.

These proceedings include papers which discuss a variety of aspects of loess—origins, deposition, distribution, landforms, distribution of vertebrate fossils, archaeological sites, and identification of paleosols of North American deposits, the loess environment of central Europe, and comparison of some American loess areas with those of North Africa.—MST

02470 **Schultz, C. Bertrand; Stout, Thompson M.** Recent progress and problems in the study of the Tertiary of Nebraska [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 21–22, 1968.

Schultz, C. Bertrand. *See* Stout, Thompson M. 02473

Schultz, Harry D. *See* Karr, Clarence, Jr. 02601

02260 **Scott, A. D.; Smith, S. J.** Mechanism for soil potassium release by drying: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 443–444, illus., 1968.

When large flakes of edge-weathered biotite were air-dried, some of the silicate layers were forced apart while others were brought closer together. Since the space between the separated layers developed into visible cracks that penetrated the inner mica core, the dry flakes provide visual evidence for a mechanism by which interlayer K can be released when soils are dried. The collapse of part of the lattice can give rise to a simultaneous occurrence of K fixation.—Authors' abstract

Scott, J. C. *See* Causey, L. V. 07405

07508 **Scott, J. S.** St. Lawrence Lowlands hydrogeological region, Chap. 4 *in* Groundwater in Canada: Canada Geol. Survey Econ. Geology Rept. 24, p. 98–119, illus., geol. maps, 1967.

This 43,000 sq-mi area, south of the Canadian Shield, extends northeasterly from northwestern Lake Huron and western Lake Erie, discontinuously to Anticosti Island. It is underlain by unfolded Paleozoic rocks, divided into three parts by two projections of the Canadian Shield, and intruded by rocks of Cretaceous age in the Montreal area. Aquifer characteristics vary from place to place with significant lithologic variations, both stratigraphically and areally. Geological reports provide basic data for qualitative assessment of ground-water resources, but detailed studies are not yet sufficient for quantitative assessment of ground-water potential. The hydrogeology is described in four parts: Ontario, west of the Frontenac axis; Ontario, east of this axis; Quebec; and Anticosti Islands. Maps in pocket show bedrock, materials of surface deposits, and ground-water sources.—GDC

07347 **Scott, James H.; Carroll, Roderick D.** Surface and underground geophysical studies at Straight Creek Tunnel site, Colorado: Highway Research Rec., no. 185 (Natl. Acad. Sci.–Natl. Research Council–Natl. Acad. Eng. Pub. 1516), p. 20–35, illus., tables, 1967.

Seismic and electrical resistivity measurements were made during and immediately after the period of construction, to obtain the velocity and resistivity of rock behind

the disturbed layer surrounding the pilot bore; values were correlated statistically with economic and engineering parameters, and quality of correlation was good. Results indicated that if correlations were established during the early stages of construction, or from previous measurements in a similar tunnel, predictions of economic and engineering parameters could be made to guide construction in the new tunnel. Accuracy of predictions based on surface measurements was tested by making surface seismic and resistivity surveys; results indicated that reasonably accurate predictions are possible. Greater accuracy would be obtained if predictions were based on geophysical logging measurements made in feeler holes drilled ahead of the working face.—*from* Authors' abstract

Scott, John C. *See* Reed, Philip C. 07406

02344 **Sebby, W. S.; Matten, L. C.** The identity of *Arnoldella* and *Kalymma* [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

07378 **Semmler, R. A.** Evaluation of iron-55 X-ray sources for portable stress analysis equipment, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 2: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 639-647, illus., 1967.

Studies on an ^{55}Fe source indicated that a truly portable diffraction camera can be developed for use with film, using currently available sources.—Author's abstract

07380 **Senftle, Frank E.; Tanner, Allan B.** Mobile X-ray fluorescence detector for mineral exploration, *in* Symposium on low-energy X- and gamma sources and applications, 2d, Austin, Tex., 1967, Proc., V. 1: Oak Ridge Natl. Lab. Rept. ORNL-IIC-10, p. 503-521, illus., 1967.

An X-ray fluorescence detector using a lithium-drifted silicon diode mounted in a vehicle has been constructed for mineral exploration over relatively flat terrain. Both isotopic and dental X-ray sources are used for excitation. This detector was built primarily to evaluate the field problems (such as scattering, matrix, etc.) in using a continuous X-ray fluorescence method and to determine whether or not such a method has practical utility. Only preliminary tests have been made to date. Scattering is a serious problem, which to a great extent is overcome by the high resolution of the solid-state counter.—Authors' abstract

SEPM. *See* Am. Assoc. Petroleum Geologists. 07462

Severinghaus, Nelson, Sr. *See* Wimpfen, Sheldon P. 02392

Sharp, Byron J. *See* Adler, Hans H. 07429

Sharp, Byron J. *See* Utah Geological Society. 07456

Sharp, R. V. *See* Allen, C. R. 02580

02205 **Shaw, Alan B.; Clark, Mary Gilman.** Paleontology of northwestern Vermont—[Pt.] 14, Type section of the Upper Cambrian Gorge Formation: Jour. Paleontology, v. 42, no. 2, p. 374-381, illus., tables, 1968.

The type section of the Gorge Formation at Highgate Falls, Vermont, has been remeasured and sampled intensively for fossils. The measured section contains 191 feet of strata but is incomplete because the basal dolomites that are found to the north are absent.—Authors' abstract

Shaw, Alan B. *See* Clark, Mary Gilman. 02206

02355 **Shaw, D. M.** A review of K-Rb fractionation trends by covariance analysis: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 573-601, illus., tables, 1968.

Analysis of K-Rb covariance in 21 suites of igneous and quasi-igneous rocks has helped resolve the question of whether the ratio K:Rb remains constant or decreases steadily during igneous differentiation. Three principal patterns exist. The first

extends from 0.002–8 percent K and 0.1–500 ppm Rb and includes a wide variety of continental and oceanic rock types; the second is of K:Rb decreasing from >3500, merging with the main trend, and shown by all and only by oceanic tholeiites and achondritic meteorites; the third is the pegmatitic-hydrothermal trend of extreme Rb concentration relative to nearly constant (or decreasing) K in the range 3 to 10 percent. Oceanic tholeiitic basalt does not contain enough Rb to be considered parent material for the continental crust-upper mantle system. A tentative model of continental crustal evolution leads to lower K:Rb by the zone-refining action of repeated anatexis.—*from* Author's abstract

02520 **Shaw, Denis M.** La géologie dans la philosophie des sciences—Ou la renaissance du Phénix: Archives Sci. 1967, v. 20, no. 3, p. 355–368, 1968.

"Philosophy of the sciences" is defined as "the interpretation of scientific statements", and a system based on "uncertain determinism" is suggested. Three factors playing roles in science are: immanence, that which is behind all the laws and rules; configuration, the thread in the weaving, scientific observations, classification; and evolution—change of position, form, and nature which accompanies the passage of time. The realm of the uncertain corresponds to the impossibility of making an exact prediction; the idea of probability in geologic statements is explored. It is an anthropomorphic image superimposed on nature by man. The gifts of geology to philosophy seemed to be lost toward the end of the 19th century. Best known ideas are of the history of the Earth and organic evolution; the struggle between these and the story of creation is discussed.—ESL

02592 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Distribution and genesis of authigenic silicate minerals in tuffs of Pleistocene Lake Tecopa, Inyo County, California: U.S. Geol. Survey Prof. Paper 597, 38 p., illus., tables, 1968.

Zeolites, monoclinic potassium feldspar, searlesite, clay minerals, and opal of diagenetic origin occur in altered rhyolitic vitric tuffs of Lake Tecopa. The zeolites, chiefly phillipsite, clinoptilolite, erionite, and minor amounts of analcime and chabazite, formed by solution of the glass, but potassium feldspar and searlesite formed from early diagenetic zeolites rather than directly from the glass. Three diagenetic facies recognized in the tuffs have fresh glass, zeolite, and potassium feldspar or searlesite as their diagnostic constituents. The fresh-glass facies is along the lake margin and is succeeded basinward by zeolite facies and then by potassium feldspar facies in the central part. The distribution of the facies is due to chemical zonation of pore water during diagenesis. Pore water was "fresh" near the margin and inlets of the lake but increasingly alkaline and saline basinward. Zonation was probably inherited from the depositional environment.—RAS

07358 **Shlemon, Roy J.** Pleistocene channels of the lower American River, Sacramento County, California [abs.]: Assoc. Pacific Coast Geographers Yearbook, v. 29, p. 158, 1967.

07439 **Short, James M.; Keil, Klaus.** Compositions and formation of metallic phases in 40 stony meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 124–125, 1967.

Sievers, Robert E. *See* Ross, William D. 02252

02264 **Sims, J. R.; Bingham, F. T.** Retention of boron by layer silicates, sesquioxides, and soil materials—[Pt.] 2, Sesquioxides: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 364–369, illus., tables, 1968.

Boron retention by hydroxy Fe and Al materials was found to be pH dependent, with maximum retention in the alkaline range and by Al materials. Aging before treatment reduced retention. Iron and aluminum precipitation from solutions by the "mole ratio" method, indicates that $Fe^{(III)}$, $Al^{(III)}$, and B were precipitated in stoichiometric proportions. Considering these forms as "solid complexes" a greater variety of complexes was found in the Al systems. Samples for each metal were prepared at three pH levels. The amount of B combined in the precipitate was determined as a function of aging; amounts in the pH 6 samples remained unchanged throughout the 42 day aging period; and in the pH 9, 10, 11 samples, decreased.

It is concluded that the ready source of hydroxy ions promoted hydrolysis of hydroxy Fe and Al precipitates, resulting in expulsion of B probably as borate ions.—*from* Authors' abstract

02265 **Sims, J. R.; Bingham, F. T.** Retention of boron by layer silicates, sesquioxides, and soil materials—[Pt.] 3, Iron- and aluminum-coated layer silicates and soil materials: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 369-373, illus., table, 1968.

Boron retention as a function of pH was determined for Fe- and Al-coated layer silicates. Treating the Na^+ and K^+ forms of vermiculite material with Al^{3+} prior to B treatment resulted in equivalent B retention. Boron retention by Al- and Fe-coated kaolinite and montmorillonite was greater than uncoated clays. A single regression line represented B retention as a function of Fe_2O_3 content for both clays. Boron retention as a function of Al_2O_3 content fell on two lines, indicating that hydroxy Fe and Al compounds in layer silicates dominate over clay minerals species *per se* in determining B retention characteristics and that B retention characteristics may be conditioned by clay mineral species. Boron retention at pH 6 by nine soil materials was correlated with free iron oxide content and 1.0*N* KCl (pH2) extractable Al_2O_3. B retention by these materials was in response to their free iron oxide and Al_2O_3 contents.—*from* Authors' abstract

02228 **Sinkankas, John.** High pressure epoxy impregnation of porous materials for thin-section and microprobe analysis: Am. Mineralogist, v. 53, nos. 1-2, p. 339-342, illus., 1968.

The process for the preparation of porous and friable materials for thin-section and microprobe analysis consists of encapsulating the specimen material in epoxy-filled rubber bags after vacuum treatment to remove trapped gases, followed by compression in a cylindrical die at 12,000 lb/in^2 to drive in the resin. After curing, samples may be sliced, ground, and polished by conventional means.—MEM

Sisco, H. G. *See* Whitehead, R. L. 02566

Smith, D. Taylor. *See* Buchan, S. 07392

02325 **Smith, H. T. U.** Nebraska dunes compared with those of North Africa and other regions, *in* Loess and related eolian deposits of the world—Internat. Assoc. Quaternary Research, 7th Cong., Boulder-Denver, Colo., 1965, Proc., V. 12: Lincoln, Nebr., Univ. Nebraska Press, p. 29-47, illus., 1968.

The author compares the sand dunes of the Nebraska Sand Hills with those of North Africa in areal extent, size, type, conditions of origin, drainage patterns, multicycle eolian activity, and proximity to belts of loess.—MST

02604 **Smith, John T., Jr.; Anson, Abraham.** (editors). Manual of color aerial photography (lst edition): Falls Church, Va., Am. Soc. Photogrammetry, 550 p., illus., tables, 1968.

This manual has nine chapters, with sub-chapters by various authors, that deal with: language of color; planning and operation of a color photographic mission; cameras, optics, and filters for color photography; color aerial films; chemistry and processing of them; techniques of color printing; sensitometry of aerial photography; and color photography from space. A tenth chapter with 23 sub-chapters deals with photographic interpretation from color aerial photographs; of these 12 relevant to geology are individually cited, also two parts of the first of three appendixes. The second appendix contains miscellaneous information, tables and charts, a glossary of terms, and bibliographic abstracts compiled by the Editor-in-Chief; the third explains the ISCC-NBS centroid color system.—GDC

Smith, S. J. *See* Scott, A. D. 02260

02287 **Smith, W. H.** A geochemical investigation of the southwest portion of the 40 Mile district, east central Alaska [abs.]: Alaska Div. Mines and Minerals Rept. 1967, p. 57 [1968].

'Smits, L. J. M. *See* Waxman, M. H. 02454

02455 **Smits, L. J. M.** SP log interpretation in shaly sands: Soc. Petroleum Engineers Jour., v. 8, no. 2, p. 123–136, illus., tables, 1968.

A theoretical equation is developed describing membrane potentials of shaly sands as a function of the cation-exchange capacity per unit pore volume and saturating water salinity, based on the same simple physical model as that employed earlier describing electrical conductivity. Experiments conducted with NaCl solutions showed that the equation is obeyed, except in the case of saturated salt solutions where minor deviations were observed. A possible explanation is given for this. As the clay content and porosity of shales may vary appreciably, shale membrane potentials also vary. Consequently, changes in membrane potentials can be accounted for by measurement of cation-exchange capacities per unit pore volume of both shales and shaly sands. Charts are given to facilitate interpretation of the electrochemical part of the SP in terms of cation-exchange capacities and the salinities of mud filtrate and formation water.—*from* Author's abstract

02446 **Snavely, Parke D., Jr.; MacLeod, Norman S.; Wagner, Holly C.** Tholeiitic and alkalic basalts of the Eocene Siletz River Volcanics, Oregon Coast Range: Am. Jour. Sci., v. 266, no. 6, p. 454–481, illus., table, 1968.

These rocks consist of a thick lower unit of tholeiitic basalt and a thin upper unit of alkalic basalt and associated porphyries. Petrochemical studies indicate that older basaltic pillow lavas of the lower unit have the most primitive composition. The abundance of porphyries in the upper unit suggests that crystal fractionation was important in production of the aphyric alkalic rocks, although some volatile transfer may have occurred. Plots of analyzed basalts show similarities to those of the Hawaiian tholeiitic and alkalic suites. The marine volcanic accumulation is typical of flows in the Tertiary eugeosyncline of the Oregon–Washington coast in early to middle Eocene, though the rocks of the upper unit are more localized. The lowermost basalts appear to be typical of basalt from the adjacent Pacific Basin whereas the upper part of the lower unit and the upper unit are similar to Hawaiian basalts.—*from* Authors' abstract

Snyder, Barry L. *See* Avers, Darrell D. 02468

02478 **Snyder, Frank G.** Tectonic history of midcontinental United States, *in* A coast to coast tectonic study of the United States: UMR Jour., no. 1 (V. H. McNutt–Geology Dept. Colloquium Ser. 1), p. 65–77, illus., tables, 1968.

Middle Precambrian metamorphic rocks were intruded by granites of several ages, part of Late Precambrian igneous activity. Late Precambrian basins can be recognized, as can Grenville-aged metamorphism in the east and a large fault lineament extending from Arkansas northeastward to the Canadian shield separating Precambrian rocks of two distinct ages. These were followed by uplift and erosion in fringing basins. A belt of Precambrian volcanic rocks, partly preserved as erosional remnants, formed a continental divide during Late Precambrian and Early and Middle Cambrian time. These are the "Ancestral Ozarks". During the Paleozoic, the area changed from positive to negative and then to stable; numerous domes, arches, and basins developed early, then came oscillation, and finally stability. Cryptoexplosion structures are described.—*from* Author's abstract

02374 **Sobieralski, V. Ralph.** Volcanic activity, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 416–417, illus., 1968.

The color aerial photograph presented, of St. Augustine Island, Alaska, is a classic for photo interpretation of volcanism. The symmetry and drainage pattern of this young cone is enhanced by drifted snow. Stereoscopic examination of the smoking caldera reveals two active vents, escarpments indicate recent faulting, and stratification of lava flows is apparent by tone and texture. Mount St. Augustine erupted in 1883, with accompanying agitated sea and a 25 to 30-ft tsunami. A month later a schooner captain reported the mountain split in two, the northern slope sunk away to cliff-line level, and a new small island lifted from the sea on the west. These features are lettered on the photograph.—GDC

02436 **Soister, Paul E.** Stratigraphy of the Wind River Formation in south-central Wind River basin, Wyoming: U.S. Geol. Survey Prof. Paper 594-A, p. A1-A50, illus., tables, geol. map, 1968.

This early Eocene formation is divided into three main units: lower fine-grained member, 0-150 feet thick, of siltstone, sandstone, claystone, and a few carbonaceous beds; Puddle Springs Arkose Member (principal uranium-bearing unit of Gas Hills district), 400-800 feet thick, of massive coarse arkose and conglomerate and minor fine-grained beds including carbonaceous material; upper transition zone, generally 50-100 feet thick, of interbedded arkose and tuffaceous mudstones. The lower member is typical of the formation elsewhere. The arkose is a piedmont alluvial fan deposit that interfingers with finer beds to the east, north, and west. Sediments of the formation, mostly fluviatile, were derived from the Sweetwater uplift and deposited on an erosion surface of high relief on the uplift's lower, north flank.—PES

07366 **Somers, Lee H.** Diving techniques as applied to geological investigations of the Great Lakes, *in* Conf. on Great Lakes Research, 10th, Toronto, Ontario, 1967, Proc.: Ann Arbor Mich., Internat. Assoc. Great Lakes Research, p. 149-156, 1967.

University of Michigan SCUBA divers made more than 300 dives in 1966 at more than 50 locations in Lakes Michigan and Huron. Bottom sediments and features were described; strike and dip of outcrops, slope of sediments, and ripplemarks measured; sediments and rock outcrops sampled; geologic features photographed; and tree trunks and peat accumulations related to lower lake stages were discovered and sampled. Special attention was given to evaluation of techniques, equipment, and personnel. Coldness of the water is the greatest limiting factor on efficiency during deep or long-duration dives. Visibility may hamper detailed observations and photography. Diver-to-surface communications enable the diver to record observations in greater detail.—*from* Author's abstract

Souther, J. G. *See* Roddick, J. A. 07493

Speidel, D. H. *See* Lindsley, D. H. 02450

02545 **Speidel, D. H.; Nafziger, R H.** P-T-oxygen fugacity relations in the system Fe-O-MgO-SiO_2: Am. Jour. Sci., v. 266, no. 5, p. 361-379, illus., tables, 1968.

The T-oxygen fugacity equilibrium for the system has been developed for a semi-quantitative T-oxygen fugacity petrogenic grid applicable to both basic igneous rocks and to meteorites. Olivine-silica-pyroxene-metallic iron-liquid exist at 1305°C and $10^{-11.8}$ atm (1 atm total), and in the system Fe-O-SiO_2 at 17.5 kb, 1280°C, and $10^{-10.8}$ atm oxygen fugacity. Subsolidus Mg enrichment of the silicate phases occurs with decreasing T and increasing oxygen fugacity in the magnetite-bearing assemblages at 1 atm. For iron-bearing assemblages, a T increase and oxygen fugacity decrease leads to Mg enrichment of the silicate phase. These phases can be divided by a region in which neither Mg nor metallic iron are stable, and transition between the two is unlikely.—*from* Authors' abstract

Spencer, R. S. *See* Rogers, W. S. 02526

07440 **Sprenkel-Segel, E. L.; Perlow, G. J.** Mössbauer determination of the ratio of olivine iron to pyroxene iron in the high-iron and low-iron group of stone meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 126-127, 1967.

Stanley, A. *See* Henoch, W. E. 07360

Stanley, A. *See* Henoch, W. E. 07361

07372 **Stehle, N. S.** Migration of bubbles in ice under a temperature gradient, *in* Physics of snow and ice—Internat. Conf. Low Temperature Sci., Sapporo, Japan, 1966, Proc., V. 1, Pt. 1: Sapporo, Japan, Inst. Low Temperature Sci., p. 219-232, illus., 1967.

Most temperate glacier ice contains numerous bubbles of trapped air segregated into alternating discontinuous gradational layers of clear and bubbly ice. This layering is a metamorphic structure and is termed foliation, although not in the usual sense, as crystals cross it. A laboratory investigation of vapor figure and bubble behavior under a temperature gradient was carried out at the Naval Civil Engineering Laboratory, Port Hueneme, Calif. Migration velocities agreed with those of Nakaya, but do not support his formula; they also supported theoretical calculations. Primary influences on migration velocity are shape, internal air pressure, and temperature. The rate is too slow to account for the large occurrences of bubble-free ice in temperate or polar glaciers.—ESL

02295 **Stevens, Anne E.; Hodgson, John H.** A study of P nodal solutions (1922–1962) in the Wickens-Hodgson Catalogue: Seismol. Soc. America Bull., v. 58, no. 3, p. 1071–1083, illus., tables, 1968.

Computer-determined P nodal solutions in the Wickens-Hodgson Catalogue were compared with earlier visually-determined solutions for the same earthquakes. Good agreement was found in about 40 percent of the solutions. Lack of agreement was due chiefly to poor distribution of data in azimuth about the epicenter. The following necessary, but not sufficient, conditions for well-defined nodal plane solutions were determined: (1) there must be a minimum of 100 ooservations with at least two in each 90° segment of azimuth, and (2) data must be at least 80 percent consistent with the selected nodal planes. Fourteen of the 618 earthquakes in the Catalogue met these requirements.—Authors' abstract

02472 **Stevenson, T. H.** Iron formation in the Cedar Bluffs till [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 22, 1968.

Stewart, David B. *See* Wright, Thomas L. 02225

02274 **Stewart, John H.; McKee, Edwin H.** Geologic map of the Mount Callaghan quadrangle, Lander County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-730, scale 1:62,500, sections, 1968.

02190 **Stewart, Wendell J.** Schubertellinae from the Wolfcamp, Lower Permian, Franklin Mountains, Texas: Jour. Paleontology, v. 42, no. 2, p. 322–328, illus., tables, 1968.

This translation from the Russian language [Akad. Nauk SSSR Geol. Inst. Voprosy Mikropaleontologii, v. 10, p. 80–87, 1966] has been revised so that the term primatheca may be applied to a primary layer, the spirotheca of the fusulinid subfamily Schubertellinae, and so that the new species name *Schubertella parva* may replace the homonym *S. minima*. Also, this translation incorporates the first description of a species of the genus *Toriyamaia* from North America, *T. americana*, and it contains descriptions of the following species of the genus *Schubertella* that were new in the Russian publication: *S. canutilloensis, orbiculata, longissima*, and *provecta*.—Author's abstract

Stockard, H. P. *See* Zietz, Isidore. 02369

Stoenner, R. W. *See* Davis, Raymond, Jr. 07322

02408 **Stoermer, E. F.** The recent and subfossil diatom flora of Lake West Okoboji, Iowa [abs.]: Jour. Phycology, v. 4, supp., p. 7, 1968.

02490 **Stoever, Edward C., Jr.** Earth science instruction in Oklahoma high schools: Oklahoma Geology Notes, v. 28, no. 3, p. 105–109, illus., tables, 1968.

A survey of earth science education in the Oklahoma secondary schools indicates rapid growth of earth science programs which is correlatable with the establishment in 1965 of the Oklahoma City Earth Science Curriculum Project Test Center and the development at the University of Oklahoma of earth science teacher preparation programs. Two major effects of this growth warrant emphasis: awareness by greater numbers of future citizens of earth science and its relations to man's social, economic, and political activities; additional employment opportunities for

professional geologists as secondary school teachers. A critical shortage of qualified teachers now exists. While geological societies and individuals in Oklahoma have and are continuing to provide support to these programs much more will be needed.—BSH

07425 **Stokes, William Lee.** A survey of southeastern Utah uranium districts, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 1–11, illus., 1967.

A brief description is given of the origin and occurrence of uranium ore in thirteen distinct mining districts: Shiprock, Monument Valley, Kaiparowits, White Canyon, Monticello, Henry Mountains, Cedar Mountain, San Rafael, Green River, Moab, Thompsons, Gateway, and Paradox. The greatest production is in the Monticello district where ore comes from Permian to Jurassic rocks.—HRC

07428 **Stokes, William Lee.** Stratigraphy and primary sedimentary features of uranium occurrences of southeastern Utah, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 32–52, illus., 1967.

Uranium has been found in more than 75 sedimentary formations in the western United States, and in the Colorado Plateau in beds from Permian to Tertiary in age. Eighteen in Utah are continental clastic formations, of which 16 are sandstones. Climate during deposition was also important; it was always arid or semiarid with circulating ground water. The area was tectonically a basin receiving sediments from all sides, with little or no exit to the sea. Most uranium comes from the Triassic and Jurassic rocks, and appears to be in channel deposits, of which several types are described. Fossil organic material, primarily logs, in the channels has tended to concentrate the uranium as well as other minor elements. The relative importance of sedimentary features in ore genesis is discussed also.—HRC

07419 **Stone, J. Fred.** Quantitative palynology of a Cretaceous Eagle Ford exposure: Compass, v. 45, no. 1, p. 17–25, illus., tables, 1967.

A technique for quantitative palynology is presented. The absolute abundance of palynomorphs from an exposure of the Arcadia Park Formation (Upper Cretaceous, Eagle Ford Group) at Dallas, Texas, is on the order of 168,000 per gram of sediment. Random lateral variation in the number of palynomorphs is observed at the exposure as revealed by the analysis of 13 samples taken at 20-ft intervals.—Author's abstract

Stout, Thompson M. *See* Schultz, C. Bertrand. 02470

02473 **Stout, Thompson M.; Schultz, C. Bertrand.** Summary of the stratigraphy of the Marsland Formation (Miocene) of Nebraska [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 22–23, 1968.

07357 **Stradling, Dale F.; Winters, Harold A.** Some major landslides of the Yakima Folds [abs.]: Assoc. Pacific Coast Geographers Yearbook, v. 29, p. 158–159, 1967.

02376 **Strandberg, Carl H.** Water pollution analysis, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 420–421, illus., 1968.

The desolation left by strip-mining operations in the Appalachian coal region is illustrated by color infrared aerial photography. Airphoto interpretation techniques do not replace existing field and laboratory analysis methods, but critical areas which require field work can be located more rapidly. From the composition of associated sulfur minerals exposed in coal mining operations, rusty iron oxide residue, usually yellowish-red, may prevent vegetation growth for 50 years or more, in which time acid-laden sediments may wash downstream. Environmental factors, little understood, cause these denuded toxic soils to image in Cyan hues when color infrared film is used. An accompanying figure is an example of the grotesque, deformed landscape thus imaged.—GDC

07395 **Strandberg, Carl H.** Aerial discovery manual: New York and London, John Wiley and Sons, 249 p., illus., tables, 1967.

The manual, intended for use in a college-level training course, is divided into three sections. The first discusses aerial photographic interpretation in seven chapters: getting acquainted with aerial reconnaissance, obtaining photography, equipment, preliminary interpretation, photographic measurements, comparative analysis, and a summary. Photogeology, the second section, is divided into basic concepts, landform, drainage pattern, soils, and terrain analysis. Section three, photohydrology, contains six chapters: ground-water analysis; analysis of streams; analysis of lakes, ponds, and reservoirs; water pollution reconnaissance; algae and higher aquatic vegetation surveys; and fish-kill surveys. Appendixes contain a comparative analysis of aerial camera systems, a glossary, and a list of state and interstate water pollution control agencies.—ESL

02498 **Strimple, Harrell L.** Biostratigraphy of the Atokan Stage [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 118, 1968.

07441 **Strong, H. M.; Hanneman, R. E.; Bundy, F. P.** Hexagonal diamonds in the Canyon Diablo meteorite and their implications [abs.]: Meteoritics, v. 3, no. 3, p. 127, 1967.

Sudo, Seiji. *See* Yasutomi, Rokyro. 02198

02388 **Sundeen, Stanley W.** Preliminary evaluations of surface mine prospects, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 54–65, 1968.

Seven basic factors to be taken into account are discussed: geography; legal status of land; historical, political, and sociological factors; geology; mining conditions; ore treatment requirements; and economic analysis. Preliminary evaluation of a surface mine project should occur at several stages in the exploration and development.—ESL

Sutton, George H. *See* Walker, Daniel A. 02294

02571 **Sutton, John.** The extension of the geological record into the Pre-Cambrian: Geologists' Assoc. Proc. 1967, v. 78, pt. 4, p. 493–534, illus., table, 1968.

In exploring, by radiometric and other recently developed methods, the Precambrian evolution of the continental masses between the Rockies and Urals, similarities in proposals for time division reflect a long-term rhythm in crustal activity related to the chelogenic cycle of 800–1000 m.y., evident in the geological history of Britain. Effects of the Katarchaean, Archaean, and Proterozoic chelogenic cycles in a wider area of the northern hemisphere suggest that orogenic processes of sedimentation, plutonism, and deformation were widespread in early stages of each cycle, became restricted to parts of regions initially affected, while stable regions became more extensive; the start of each cycle initiated new networks of mobile belts. Characteristic features of the three cycles are compared and progressive changes in crustal behavior at equivalent stages of successive cycles are examined.—GDC

Sutton, R. G. *See* Woodrow, D. L. 07367

02372 **Swanson, Lawrence W.** Shoreline mapping, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 410–411, illus., 1968.

A color aerial photograph of the southwest coast of Middleton Island, Alaska, taken by the U.S. Coast and Geodetic Survey in August 1964 after the earthquake of March 27, illustrates the improvements made in photogrammetric methods and shows detail of reconnaissance information not previously obtained. Terrace elevations of six stages of uplift prior to the earthquake are given by overlay, as well as other features. Horizontal differences between points along each terrace indicate a tilting of the island, justification for installing a tiltmeter for further movement study. Offshore bottom details could be clearly determined by color contrast.—GDC

02381 **Swinney, C. M.; Waters, A. C.; Miller, C. P.** Reconnaissance geologic map of the Lookout Mountain quadrangle, Crook and Wheeler Counties, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-543, scale 1:62,500, 1968.

Sylvester, Arthur G. *See* Lipps, Jere H. 02192

07461 **Szabo, B.** Ocean gravity surveys with airborne systems, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 201–204, illus., table, 1967.

Tests designed to improve the quality of aerial gravimetry were begun by the U.S. Air Force Cambridge Research Laboratories in 1965. Goals were to select components of a complete measuring system, to derive data reduction methods including computer programs, and to resolve the downward continuation problem of gravity for obtaining useful ground or sea-level values from high-altitude aerial profiles. The equipment, listed and described briefly, was tested in flights over California and the south- and north-central United States. From preliminary reduction and analysis of measurements, it can be seen that the Askania-Graf instrument performed better than the LaCoste and Romberg. Both instruments are acceptable for global surveys provided navigation errors are reduced. Various problems in the computer program for data reduction are examined.—VSN

02352 **Takahashi, Taro; Bassett, William A.; Mao, Ho-Kwang.** Isothermal compression of the alloys of iron up to 300 kilobars at room temperature—Iron-nickel alloys: Jour. Geophys. Research, v. 73, no. 14, p. 4717–4725, illus., tables, 1968.

The effect of pressure on the crystal structure and the molar volume of iron alloyed with 5 and 10 percent nickel was determined up to 300 kb at room temperature by means of X-ray diffraction techniques employing a diamond-anvil high-pressure cell. The alloys undergo a reversible bcc-hcp phase transformation, which is accompanied by a volume change of -0.36 ± 0.02 cu cm per mole. The crystallographic axis ratio, c:a, of the hcp phase appears to increase with nickel content, whereas it appears to be unaffected by pressure. The bulk moduli calculated from the volume data for the bcc and hcp phases of the alloys do not differ significantly from those for the respective phases of iron.—*from* Authors' abstract

02536 **Takahashi, Taro; Broecker, Wallace; Li, Yuan Hui; Thurber, David.** Chemical and isotopic balances for a meromictic lake: Limnology and Oceanography, v. 13, no. 2, p. 272–292, illus., tables, 1968.

Study of the waters and sediments of Green Lake, Fayetteville, N.Y., shows the cause of its meromixis to be two different water types entering the lake. Water entering below the chemocline is almost twice as saline as that entering the surface layer. For carbon and its isotopes, the contributions of $CaCO_3$ precipitation, of the photosynthetic cycle, of gas exchange with the atmosphere, and of hydrologic transport are considered. Results indicate a mean residence time of two years for surface water and of 4–30 yr for deep water. Water entering the deep reservoir must be richer in $Na^+ + K^+ + Cl^-$ relative to $Mg^{2+} + Ca^{2+} + HCO_3^- + SO_4^{2-}$ than that entering the surface. Its carbon must also be more deficient in C-13 and C-14 and its degree of supersaturation with respect to calcite lower than surface water; precipitation takes place largely from surface water.—*from* Authors' abstract

Tanner, Allan B. *See* Senftle, Frank E. 07380

02474 **Tanner, Lloyd G.; Martin, Larry D.** Notes on lower Oligocene hyracodontids [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 23, 1968.

02414 **Taylor, Alfred R.; Luft, Stanley J.; Lewis, Richard Q., Sr.** Geologic map of the Greensburg quadrangle, Green and Taylor Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-739, scale 1:24,000, section, text, 1968.

The Greensburg gas field supplied gas for Campbellsville and local carbon black plants from 1910 through the early 1930's; domestic supplies are obtained currently. Gas occurs in vuggy limestone 2–32 feet beneath the Chattanooga Shale; locally it is found just above the Chattanooga in the Fort Payne Formation. The Pitman

oil pool yielded from wells an average of 30–35 bbl per day in 1958 and 1959 from less than 500 feet in depth. Three zones beneath the Chattanooga contain oil, the middle zone being the most important. Over large areas the Salem and Warsaw Limestones and the Fort Payne Formation contain limestone suitable for aggregate and agricultural purposes.—MCM

07451 **Taylor, L. G.** Bathymetric maps for Continental Shelf development, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 255–259, illus., 1967.

General problems related to making bathymetric maps for use in studies of the sea bottom are examined. Such maps are important for data presentation in many studies such as temperature, gravity, magnetism, bottom and subbottom geology, mining, pollution control, and so forth. Many areas need to be resurveyed and marine geodesy plays an important role in the development of systems for determining precise position location, coordinate points in the oceans and on land, and data relating to size and shape of the Earth. Mapping projects underway in the Coast and Geodetic Survey consist of a basic 1:250,000 scale series for the Continental Shelf, supplemented by a 1:125,000 scale series of the Mid-Atlantic Shelf and a 1:400,000 series of the Aleutian Arc.—VSN

02572 **Taylor, O. James.** Ground water resources of the northern Powder River valley, southeastern Montana: Montana Bur. Mines and Geology Bull. 66, 34 p., illus., tables, 1968.

In southeastern Montana, consumers depend on ground water from the Fox Hills Sandstone and Hell Creek Formation of Cretaceous age, the Fort Union Formation of Paleocene age, and Quaternary alluvium and terrace deposits. The structure of these formations is shown on a geohydrologic map by contours prepared from oil-test logs. The artesian Cretaceous aquifers transmit about 820 gpd, are recharged in the southeast, and the water moves northwest to discharge into the Yellowstone River valley. The Fort Union aquifers are presumably recharged in various places; ground water moving north is discharged through springs. The unconfined water from alluvium and terrace deposits is hard. Supplies will be adequate for many years, provided new wells are properly constructed and pressures not lowered by waste of water.—GDC

02311 **Taylor, T. N.** The scanning electron microscope, a new research tool in paleobotany [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 722, 1968.

Taylor, T. N. *See* Delevoryas, T. 02322

02323 **Taylor, T. N.; Eggert, D. A.** A new pteridosperm seed from the Upper Pennsylvanian of Illinois [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 726, 1968.

02349 **Taylor, T. N.; Eggert, D. A.** Preliminary report on a compression-impression flora from the Upper Mississippian of Arkansas [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 723, 1968.

02257 **Tedrow, J. C. F.** Pedogenic gradients of the polar regions: Jour. Soil Sci., v. 19, no. 1, p. 197–204, illus., table, 1968.

Soils of the polar regions are divided into three zones: Arctic Brown, Polar Desert, and Cold Desert. The first coincides approximately with the arctic tundra belt, the second is penecontiguous with the high arctic, and the last is represented by ice-free parts of Antarctica. These three zones are sectors of a pedogenic gradient. Progressing from northern fringes of forested land, to colder climates, precipitation decreases, organic matter in the soil decreases, and soil pH values tend to increase.—ESL

02583 **Terasmae, J.** Some problems of the Quaternary palynology in the western mainland region of the Canadian Arctic: Canada Geol. Survey Paper 68-23, 26 p., illus., table, 1968.

Problems in palynology of Quaternary deposits in the western Canadian Arctic are summarized and evaluated. Certain aspects of pollen production, dispersal and deposition are of relatively greater importance than in more southern latitudes. In the interpretation of the fossil pollen record, the need is emphasized for awareness of limiting factors evident in palynological techniques. It is important to integrate such interpretations with evidence from other sources, such as glaciology, Quaternary geology, climatology, dendrochronology, geobotany and ecology, for meaningful paleoecological and paleoclimatological reconstructions. Results indicate a causal relation between Arctic vegetation and climate and hence, confirm the validity and usefulness of palynological studies in the investigation of postglacial and Quaternary environmental changes.—*from* Author's abstract

Theodore, T. G. *See* Allen, C. R. 02580

07368 **Thom, B. G.** Humate and coastal geomorphology: Louisiana State Univ. Coastal Studies Bull. 1 (Tech. Rept. 37), p. 15–17, 1967.

Humate is the term applied to gel-like humic substances carried by natural waters through void spaces in sediments; it cements the sand to form a hardpan which perches the water table, and is especially well developed in Pleistocene coastal deposits of the southeastern United States and eastern Australia. Its occurrence in pre-Holocene barriers and fluvial terraces is described. The process forming humate seems to be associated with the position of the water table during the Quaternary. It is suggested that the humate of a given terrace or barrier formed during rising sea level following a period of low sea level, and would be added to during succeeding cycles.—ESL

Thom, B. G. *See* Gagliano, S. M. 07373

Thomas, Chester E., Jr. *See* Cervione, Michael A., Jr. 02430

07340 **Thomas, P. D.** Background on geodetic principles and theories, *in* Marine geodesy symposium, 1st, Columbus, Ohio, 1966, Proc.: Washington, D.C., U.S. Government Printing Office, p. 9–25, illus., table, 1967.

The hypothesized internal structure and knowledge of the figure of the Earth and the contributions from data of satellite orbits are reviewed. The province of geodesy includes establishment of horizontal and vertical control nets; observations of gravity over the Earth and of secular variations in latitude, gravity, and earth tides; accurate geodetic frameworks for referencing special studies such as space vehicle launching; and extension of astronomic investigations. Geodesy is of importance to upper mantle and crustal studies and associated tectonic and geophysical phenomenon because it provides accurate position determinations of all land, sea, and air observing stations. The geodetic control network of the U.S. Coast and Geodetic Survey is shown with the proposed United States program for the International Upper Mantle Project.—VSN

07442 **Thompson, S. O.; Schaeffer, O. A.** The chlorine-36 content of the iron meteorites, Canyon Diablo and Otumpa [abs.]: Meteoritics, v. 3, no. 3, p. 129, 1967.

07427 **Thomson, Kenneth C.** Structural features of southeastern Utah and their relations to uranium deposits, *in* Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, p. 23–31, illus., 1967.

The structures in the southeastern Utah part of the Colorado Plateau played a large part in the deposition of uranium in this important area. If one would inspect the regional structure, one would find that there is a coincidence of the principal region of productive deposits in the Morrison Formation with the regions of salt anticlines. These anticlines probably have had an important part to play in the formation of these deposits.—Author's conclusions

02508 **Thrower, Norman J. W.; Cooke, Ronald U.** Scales for determining slope from topographic maps: Prof. Geographer, v. 20, no. 3, p. 181–186, illus., 1968.

Slope of the land is an important attribute of landscape to geographers, geologists, land planners, engineers and other field scientists, and one of the most difficult to measure with precision. Most easily derived by converting contour spacings on topographic maps into degrees of slope, percentage of slope, or some simple ratio, the indirect recovery is conditioned by accuracy of initial slope observations and by scale of the map and its contour interval. Natural curves and contour-eliminated small features are problems that need generalized values. The slope indicators illustrated were developed for making rapidly a great many slope measurements of highly varied terrain. Accuracy of the scales declines as slope increases.—GDC

Thurber, David. *See* Takahashi, Taro. 02536

07468 **Tocher, Don; Nason, Robert.** Fault creep at the Almaden–Cienega Winery, San Benito County, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Secs., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 99–101, illus., 1967.

The winery, south of Hollister, Calif., and situated on the main trace of the San Andreas fault, was rebuilt in 1948, by 1954 parts near the line of creep had to be rebuilt, and by 1956 concrete walls and slabs were offset by four inches. Displacement of a half inch a year occurs in events of several days to a week's duration, but sudden offset may occur at times of earthquakes.—ESL

Tocher, Don. *See* Nason, Robert. 07470

02310 **Traverse, Alfred.** What is sporopollenin? [abs.]: Am. Jour. Botany, v. 55, no. 6, pt. 2, p. 722, 1968.

Trettin, H. P. *See* Blackadar, R. G. 02441

Trettin, H. P. *See* Blackadar, R. G. 02460

Trettin, H. P. *See* Blackadar, R. G. 02461

Trettin, H. P. *See* Blackadar, R. G. 02462

Trettin, H. P. *See* Blackadar, R. G. 02463

02273 **Trexler, J. Peter; Wood, Gordon H., Jr.** Geologic map of the Lykens quadrangle, Dauphin, Schuylkill, and Lebanon Counties, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ–701, scale 1:24,000, sections, 1968.

Trombka, J. *See* Adler, I. 07476

02547 **Truesdell, A. H.; Christ, C. L.** Cation exchange in clays interpreted by regular solution theory: Am. Jour. Sci., v. 266, no. 5, p. 402–412, illus., table, 1968.

Regular solution theory is used to calculate the values of thermo-dynamic exchange constants from experimental curves obtained in the titration of hydrogen-saturated clays by strong bases. Investigated were the exchanges in the hydrogen clays beidellite, illite, kaolinite and bentonite upon titration with KOH, NaOH, or NH_4OH. In agreement with the results of Garrels and Christ (1950) and Blackmon (1958), it is found that a single hydrogen clay behaves as a mixture of two distinct weak acids, that is, each clay contains two energetically different homogeneous sets of exchange sites, with the equivalent exchange capacity of the first site much larger than that of the second site.—Authors' abstract

02356 **Turekian, Karl K.** Deep-sea deposition of barium, cobalt and silver: Geochim. et Cosmochim. Acta, v. 32, no. 6, p. 603–612, tables, 1968.

The accumulation rates of Ba, Co, and Ag have been determined in a Mid-Atlantic Ridge core from the South Atlantic (Lamont core V 16–36) in which clay accumulation rate is about 0.1 g per sq cm per 1000 yr and the concentrations of Co and Ba were previously shown to be the highest in the Atlantic (on a carbonate-free basis). Comparison of accumulation rates with supply rates of these

elements by streams as dissolved, desorbable, and detrital loads indicate that continental supply is adequate to account for the observed accumulation rates in V 16-36 and by deduction for the Atlantic as a whole. Trace-element concentration patterns in the Atlantic Ocean are thus explainable on the basis of continental supply alone while not ruling out minor contributions from other sources.—Author's abstract

Turekian, Karl K. *See* Veeh, H. Herbert. 02537

Twiss, P. C. *See* Wilson, John Andrew. 02443

02503 **Untersteiner, N.; Nye, J. F.** Computations of the possible future behaviour of Berendon Glacier, Canada [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 205-213, illus., table, 1968.

If the surface of Berendon Glacier, British Columbia, rose by 19 m above its 1963 level at a certain point near the terminus it would reach the entrance to a mining tunnel. Computations are made to see whether this is likely in the near future. The method used fits polynomials to the advance-retreat data and then uses the λ coefficients of Nye (1963) to infer the corresponding mass balance behaviour. It is concluded that if the mean mass balance should increase smoothly to +70 cm per yr by the year 2003, the ice would reach the tunnel portal in 2003. But, even assuming a drastic deterioration in climate and a concomitant increase of the mean mass balance, the ice will not reach the portal within the next 20 years.—*from* Authors' abstract

02499 **Urban, Logan L.** Palynology of the Drywood and Bluejacket coals (Pennsylvanian) of Oklahoma [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 118-119, 1968.

07443 **Urey, Harold C.** On the origin of chondrules and chondrites [abs.]: Meteoritics, v. 3, no. 3, p. 129-130, 1967.

02394 **U.S. Air Force.** (Aeronaut. Chart and Inf. Center, compiler). Transcontinental geophysical survey (35°-39° N)—Bouguer gravity map from 112° W longitude to the coast of California: U.S. Geol. Survey Misc. Geol. Inv. Map I-532-B, scale 1:1,000,000, 1968.

02395 **U.S. Air Force.** (Aeronaut. Chart and Inf. Center, compiler). Transcontinental geophysical survey (35°-39° N)—Bouguer gravity map from 100° to 112° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I-533-B, scale 1:1,000,000, 1968.

02396 **U.S. Air Force.** (Aeronaut. Chart and Inf. Center, compiler). Transcontinental geophysical survey (35°-39° N)—Bouguer gravity map from 87° to 100° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I-534-B, scale 1:1,000,000, 1968.

02456 **U.S. Army Corps Engineers.** (Mobile District). Pascagoula River comprehensive basin study—V. 1, Summary report: [Mobile, Ala.] U.S. Army Corps Engineers, 122 p., illus., tables, 1968.

The consolidated results of a comprehensive study of the Pascagoula River Basin include: a physical description of the basin and present state of water and related land resource development; its past, present, and projected economy; present and future needs for such resource development; alternatives for meeting those needs; a comprehensive plan with a framework for long-range planning and an early-action program for immediate needs; and recommendations for implementing the comprehensive plan. Fourteen appendixes, presenting details covering specific disciplines and features of the study, are outlined in this report. Published in separate volumes, the following appendixes are cited individually: D, engineering studies for major reservoirs; K, geology and ground-water resources; L, mineral resources and industry.—GDC

02457 **U.S. Army Corps Engineers.** (Mobile District). Engineering studies for major reservoirs, App. D *in* Pascagoula River comprehensive basin study, V. 3: [Mobile, Ala.] U.S. Army Corps Engineers, 178 p., illus., tables, 1968.

This appendix is devoted principally to engineering studies [in southeastern Mississippi and adjacent part of Alabama] for major reservoirs in the early-action program and to related investigations and material. It contains Corps authorities for participation in this comprehensive study; brief summaries of prior reports; summaries of hydrology studies concerning water availability, storm types, floods, and flow frequencies; flood damage studies; general design criteria; project formulation studies and descriptions of early-action major reservoir projects; navigation studies; and hydroelectric power studies. Also included are sedimentation studies performed for the Corps of Engineers by the Department of Agriculture.—*from* Introduction

U.S. Bureau of Mines. *See* U.S. Geological Survey. 07523

07498 **U.S. Bureau of Reclamation.** Geological considerations, Chap. 2 *in* Rehabilitation of Eklutna Project features following earthquake of March 1964—A supplement to Eklutna Dam, Tunnel and Powerplant, technical record of design and construction, March 1958: Denver, Colo., U.S. Bur. Reclamation, p. 15–23, illus., 1967.

The Knik River and Eklutna Lake and Creek, Alaska, all lie in old glacial valleys. Further drilling in the area of the intake structure revealed no significant changes due to the 1964 earthquake in the compact glacial till, and the new intake structure rests on this. Exploration for a site for a new dam farther downstream, located one with a foundation of firm glacial till overlain on the abutments by gravelly clay. Much of the latter was removed. Maps showing topography, surface geology, and bedrock contours, and a section are included.—ESL

02424 **U.S. Coast and Geodetic Survey.** United States—East coast, Maine, Casco Bay—Soundings (C. and G.S. 315, 15th edition): Washington, D.C., U.S. Coast and Geod. Survey, scale 1:40,000, 1968.

02425 **U.S. Coast and Geodetic Survey.** Atlantic coast, Cape Sable to Cape Hatteras—Soundings (C. and G.S. 1000, 21st edition): Washington, D.C., U.S. Coast and Geod. Survey, scale 1:1,200,000, 1968.

02411 **U.S. Geological Survey.** Ground-water levels in the United States, 1961–65—Northwestern States: U.S. Geol. Survey Water-Supply Paper 1845, 199 p., illus., tables, 1968.

Ground-water levels for 1961–65 are given for Alaska, Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming.—MCM

02417 **U.S. Geological Survey.** Aeromagnetic map of the Hampden quadrangle, Hampden County, Massachusetts, and Tolland County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-629, scale 1:24,000, 1968.

02418 **U.S. Geological Survey.** Aeromagnetic map of the Monson quadrangle, Hampden County, Massachusetts, and Tolland County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-630, scale 1:24,000, 1968.

02419 **U.S. Geological Survey.** Aeromagnetic map of the Southbridge quadrangle, Worcester County, Massachusetts, and Windham and Tolland Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-631, scale 1:24,000, 1968.

02420 **U.S. Geological Survey.** Aeromagnetic map of the Springfield South quadrangle, Hampden County, Massachusetts, and Hartford and Tolland Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-632, scale 1:24,000, 1968.

02421 **U.S. Geological Survey.** Aeromagnetic map of the Wales quadrangle, Hampden and Worcester Counties, Massachusetts, and Tolland County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-633, scale 1:24,000, 1968.

02422 **U.S. Geological Survey.** Aeromagnetic map of the Webster quadrangle, Worchester County, Massachusetts, and Windham County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-634, scale 1:24,000, 1968.

02423 **U.S. Geological Survey.** Aeromagnetic map of the West Springfield quadrangle and part of the Southwick quadrangle, Hampden County, Massachusetts, and Hartford County, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-635, scale 1:24,000, 1968.

07523 **U.S. Geological Survey; U.S. Bureau of Mines; Alabama Geological Survey; Alabama Oil and Gas Board.** Mineral and water resources, Butler County, Alabama: Alabama Geol. Survey Inf. Ser. 36, 36 p., illus., tables, 1967.

The geology, and water and mineral resources of Butler County are summarized in three sections with separate references. Cretaceous to Quaternary rocks are exposed, and the formations, briefly described, dip southwestward with lessening steepness with some local faulting and solution slumping. The principal aquifers are sand beds in the Eutaw, Ripley, and Nanafalia Formations, and limestone in the Clayton Formation. Depth to water, and thickness, lithology and water-bearing qualities of all units are summarized and records of wells and springs tabulated, along with chemical analyses of water. Potential reserves are estimated for iron ore, clay, sand, and limestone. About five million tons of brown iron ore has been mined since 1929.—GDC

02412 **U.S. Library of Congress.** (Sci. and Technology Div.). Bibliography on snow, ice and frozen ground, with abstracts: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. CRREL Rept. 12, v. 22, 232 p., 1968.

07456 **Utah Geological Society; Hintze, Lehi F.; Rigby, J. Keith; Sharp, Byron J.** (editors). Uranium districts of southeastern Utah: Utah Geol. Soc. Guidebook to Geology of Utah, no. 21, 193 p. illus., tables, 1967.

This guidebook consists of ten papers and two road logs. Eight papers discuss the uranium deposits of the Colorado Plateau, including structure and stratigraphy of uranium-bearing rocks, history of development of the deposits and their production, relation of stable isotopes to the deposits, geologic (isotope) ages of the deposits, and effect of the industry on the economy of Utah. One paper discusses uranium deposits of northeastern and western Utah and another lists and comments on the principal literature on uranium. The exit-entrance road log, between Salt Lake City and Moab, includes not only the standard outcrop comments but also discussions of the various districts visited. Papers are cited individually.—HDG

Valentine, James W. *See* Lipps, Jere H. 02202

07520 **Valentine, James W.** The influence of climatic fluctuations on species diversity within the Tethyan provincial system, *in* Aspects of Tethyan biogeography—A symposium: Systematics Assoc. Pub. 7, p. 153–166, illus., 1967.

In diversification of Tethyan faunas, North American species are comparable to European. Latitudinal ranges of mid-Mesozoic species are considerably greater than of living forms, but tend to decrease during late Mesozoic and Cenozoic. Today a low mean range frequency and high rate of faunal change are associated with provincial regions separated by thermal barriers. Simple models show that the world's shelled molluscan benthos has increased in species number, due to range restrictions based on increasing thermal gradients between equator and poles. Trends toward decreasing provinciality promote extinction rather than diversification; warming climates promote faunal reduction; fluctuating climates enhance diversity during their deterioration and retain some new lineages during amelioration. Tethyan fauna was enriched thusly and by extra-Tethyan recruitment.—GDC

02293 **Vanek, Jirí.** Amplitude curves of seismic body waves between 5° and 25°: Seismol. Soc. America Bull., v. 58, no. 3, p. 1035–1039, illus., 1968.

Amplitude–distance curves of seismic body waves in the distance range between 5° and 25° are presented. The shape of the amplitude curves indicates the complex character of wave groups denoted as P and S. It appears that these wave groups are composed of many wave types which arrive in comparable traveltimes and produce a complicated interference pattern of the P– and S–wave groups. At different epicentral distances different wave types predominate, thus forming the maximum of the wave group in question.—*from* Author's abstract

Vaughan, R. H. *See* Waters, A. C. 02382

02537 **Veeh, H. Herbert; Turekian, Karl K.** Cobalt, silver, and uranium concentrations of reef–building corals in the Pacific Ocean: Limnology and Oceanography, v. 13, no. 2, p. 304–308, illus., tables, 1968.

A study was made of the concentration of silver, cobalt, and uranium in the calcium carbonate skeletons of reef–building corals, using neutron–activation analysis. The silver, cobalt, and uranium concentrations in the corals vary considerably, with mean values of 0.041 ppm Ag, 0.005 ppm Co, and 2.2 ppm U. The Ag:Ca and Co:Ca ratios in the corals are much lower than those reported for open ocean water from the same general area, showing that corals discriminate against these trace elements during the deposition of their aragonite skeletons. The U:Ca ratios in the corals on the average appear to approach that of seawater with a slight discrimination against uranium. Variations among species from the same locale, beyond the limits of analytical error, further suggest biochemical control by the corals in the incorporation of uranium in the skeleton.—Authors' abstract

02519 **Velde, Bruce.** The Si^{+4} content of natural phengites—A reply [to 1968 discussion by E. H. Brown of 1965 paper]: Contr. Mineralogy and Petrology, v. 17, no. 1, p. 82–84, 1968.

There is apparent discordance between experimental and natural mineral data for the phengitic micas. It is hoped that further investigations and debate on their significance might permit recognition of some principles useful to metamorphic petrology. The variability range of Si content in those from Ile de Groix, France, is limited, despite a considerable mineral variation in rock composition. Reference to "relative abundance of other elements in the mica" was meant to express a crystallo–chemical relation, not a mathematical one. The original study did not represent a general treatment of the phengite problem in all metamorphic phases. However, a sufficiently regular chemical response of phengites might allow general interpretations of physical conditions of metamorphism.—GDC

02289 **Viereck, Leslie A.** Botanical dating of recent glacial activity in western North America, Chap. 10 *in* Arctic and alpine environments—Internat. Assoc. Quaternary Research, 7th Cong., Boulder–Denver, Colo., 1965, Proc., V. 10: Bloomington, Ind., and London, Indiana Univ. Press, p. 189–204, illus., table, 1968.

Tree–ring analysis and lichen growth rates provide useful methods for dating glacial events during the past 500 years, for which radiocarbon methods are of little use. This paper gives botanical dates of historical maxima and main advances of 51 glaciers in Washington, Oregon, British Columbia, and Alaska, including original dates by Viereck on 14 glaciers in south–central Alaska. All areas show a glacial maximum in the past 300 years that was the greatest in the past 5 to 10 centuries, and probably greatest since late–glacial time. All regions show evidence of advances in each of the past three centuries, although one or more of these advances may not be evident in local areas.—VMJ

Vorhis, Robert C. *See* McGarr, Arthur. 02247

02362 **Vortman, L. J.** Craters from surface explosions and scaling laws: Jour. Geophys. Research, v. 73, no. 14, p. 4621–4636, illus., tables, 1968.

Scaling laws for craters from surface explosions are derived from the nuclear explosions and applicable chemical explosions to date. The data are insufficient for defining scaling more accurately than by a first–order power law. Nuclear and chemical explosions are consistent in indicating that of the crater radii scale as a

power of energy larger than 1/3. A possible explanation of the larger scaling is hypothesized.—Author's abstract

02229 **Wada, Koji; Yamada, Hiroshi.** Hydrazine intercalation–intersalation for differentiation of kaolin minerals from chlorites: Am. Mineralogist, v. 53, nos. 1–2, p. 334–339, illus., 1968.

Differentiation of the diffraction peak of kaolin minerals (001) from that of chlorite (002) at 7 A can be accomplished by hydrazine intercalation followed or not followed by intersalation. Following the procedures outlined for hydrazine intercalation–intersalation the presence of the 7 A kaolin mineral can be proven conclusively even in the presence of chloritic minerals.—MEM

Waddell, K. M. *See* Hood, J. W. 02431

Wagner, Holly C. *See* Snavely, Parke D., Jr. 02446

Walawender, M. J. *See* Davis, B. L. 02447

02517 **Waldbaum, D. R.** High-temperature thermodynamic properties of alkali feldspars: Contr. Mineralogy and Petrology, v. 17, no. 1, p. 71–77, tables, 1968.

Recent hydrofluoric acid solution calorimetric data are used to derive standard enthalpies and Gibbs free energies of formation of low-albite, high-albite, $NaAlSi_3O_8$ glass, microcline, sanidine, and $KAlSi_3O_8$ glass. The data are presented as high-temperature functions from 298.15° to 1400°K.—Author's abstract

Waldbaum, David R. *See* Robie, Richard A. 02434

02512 **Waldrop, L.** Crystal structure of triploidite: Naturwissenschaften, v. 55, no. 6, p. 296–297, table, 1968.

Measurements on triploidite from Branchville, Conn., show cell dimensions: $a=12.366$ A, $b=13.276$ A, $c=9.943$ A, $\beta=108.230°$. Positional coordinates are tabulated and are very similar to triplite, since it has a triplite substructure. The triploidite cell is related to that of triplite by having a doubled b axis. Further least-squares refinement is being carried out.—ESL

02294 **Walker, Daniel A.; Sutton, George H.** The agreement of proposed Earth models with observed body-wave travel times: Seismol. Soc. America Bull., v. 58, no. 3, p. 1059–1069, illus., tables, 1968.

A computer program was used to evolve a model of compressional and shear-wave velocity for the Earth's mantle which would be consistent with the traveltimes given in the Jeffreys-Bullen (J-B) tables. The sensitivity shown by our computed traveltimes to changes in layer velocities suggests that models containing low velocity channels would produce traveltimes different from those given in the tables. Traveltimes associated with velocity models proposed by others were also computed. The significance of traveltime residuals depends primarily on the reliability of observed traveltimes for those epicentral distances at which the model fails. Authors' abstract

07479 **Walker, H. J.** Riverbank dunes in the Colville delta, Alaska: Louisiana State Univ. Coastal Studies Bull. 1 (Tech. Rept. 36), p. 7–14, illus., 1967.

Both active and stabilized dunes are present in the Colville delta; the latter are long narrow ridges cut into sections by wind action, and their orientation indicates they formed as foredunes prior to shifting of the river channels. Delta dunes, composed of very fine sand and all to the lee of sandbars and mudflats, reflect the dominant wind direction. Active dunes are either at the front of the delta on the inner portion of the mudflats or on the left bank of the river and its distributaries. The latter are long, wide foredunes, with sinuous crests caused by blowouts. During flooding, more sediment is deposited on the bars, but it is not always available to the wind as snow blankets both dunes and bars much of the year. Permafrost, depressed

under areas of dune sand, is responsible for perched lakes. Conditions in the delta are ideal for formation of foredunes along riverbanks.—ESL

07444 **Walker, Walter W.** A metallurgical study of some fragments of the Canyon Diablo meteorite [abs.]: Meteoritics, v. 3, no. 3, p. 131–132, 1967.

07445 **Wänke, H.** Cosmic-ray exposure ages, orbits and origin of meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 133, 1967.

02475 **Warren, Andrew.** Dune volume and trend measurements in the Nebraska sandhills [abs.]: Nebraska Acad. Sci. Proc., 78th Ann. Mtg., p. 23, 1968.

Warren, Charles R. *See* Denny, Charles S. 02291

02370 **Warren, David H.** Transcontinental geophysical survey (35°–39° N)—Seismic refraction profiles of the crust and upper mantle from 74° to 87° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I–535–D, scale 1:1,000,000, separate text, 1968.

The text is identical with that accompanying Map I–532–D (Warren, 1968).—MCM

02385 **Warren, David H.** Transcontinental geophysical survey (35°–39° N)—Seismic refraction profiles of the crust and upper mantle from 112° W longitude to the coast of California: U.S. Geol. Survey Misc. Geol. Inv. Map I–532–D, scale 1:1,000,000, separate text, 1968.

In this interim compilation prepared in cooperation with the Advanced Research Projects Agency, recent publications and some in press on seismic studies of the crust of continental United States and sources of data are listed. Where a newer, more detailed refraction survey has been available, older work in the same area has not been included, nor have those that did not penetrate to the M-discontinuity. Data are shown in a manner that results from standard assumptions in interpretation of refraction surveys: sharp boundaries between layers, layers of constant velocity, and increasing velocity with depth. Results are shown as perspective fence diagrams extending between shotpoints, and all velocity and depth values are listed in a table. Each instance of alteration of interpretation from published form is described and referred to by number in Data References.—MCM

02386 **Warren, David H.** Transcontinental geophysical survey (35°–39° N)—Seismic refraction profiles of the crust and upper mantle from 100° to 112° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I–533–D, scale 1:1,000,000, separate text, 1968.

The text is identical with that accompanying Map I–532–D (Warren, 1968).—MCM

07446 **Wasson, John T.; Wetherill, George W.** The origin of the iron meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 134, 1967.

02389 **Waterman, Glenn C.; Hazen, Scott.** Development drilling and bulk sampling, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 69–102, illus., tables, 1968.

Development drilling is directed toward determining the grade, volume, and three-dimensional outline of a previously located mineralized zone. Testing methods described are: pits, shafts, and tunnels, and churn, diamond, percussion, and rotary drilling. Problems pertinent to copper, iron, and coal deposits; control of data; and bulk sampling are discussed. Ore reserve calculations are divided into conventional and statistical methods. Water and flood control is also a problem that development drilling can help solve. Modern development practices in four copper mines, Mesabi taconite and Quebec iron mines, and coal, uranium, bauxite, nitrate, beach-sand, and molybdenum mines are discussed.—ESL

Waters, A. C. *See* Swinney, C. M. 02381

02382 **Waters, A. C.; Vaughan, R. H.** Reconnaissance geologic map of the Ochoco Reservoir quadrangle, Crook County, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-541, scale 1:62,500, 1968.

02454 **Waxman, M. H.; Smits, L. J. M.** Electrical conductivities in oil-bearing shaly sands: Soc. Petroleum Engineers Jour., v. 8, no. 2, p. 107–122, illus., tables, 1968.

A simple physical model was used to develop an equation that relates the electrical conductivity of a water-saturated shaly sand to the water conductivity and the cation-exchange capacity per unit pore volume of the rock. This equation fits both the experimental data of Hill and Milburn and data obtained recently on selected shaly sands with a wide range of cation-exchange capacities. This model was extended to cases where both oil and water are present in the shaly sand. This results in an additional expression, relating the resistivity ratio to water saturation, water conductivity and cation-exchange capacity per unit pore volume. The effect of shale content on the resistivity index-water saturation function is demonstrated by several numerical examples.—Authors' abstract

02540 **Weaver, Charles E.** Mineral facies in the Tertiary of the continental shelf and Blake Plateau: Southeastern Geology, v. 9, no. 2, p. 57–63, illus., 1968.

X-ray analyses of JOIDES core samples from the Continental Shelf and Blake Plateau [off Florida] show the presence of a variety of authigenic materials. Calcite is the dominant carbonate mineral in the Eocene and Oligocene sediments. In the Miocene sediments dolomite is the dominant carbonate mineral in the west and calcite in the east. Phosphatic sand is abundant in the Miocene shelf facies. K-feldspar is a major component of the western Eocene limestone residues and clinoptilolite of the eastern Eocene and Oligocene. The Lower Miocene contains an abundance of attapulgite and sepiolite, and the Upper Miocene montmorillonite. The pre-Miocene silicate minerals are believed to be largely authigenic and the post-Oligocene ones largely detrital.—Author's abstract

Weaver, D. W. *See* Kleinpell, R. M. 07463

02270 **Weed, S. B.; Leonard, R. A.** Effect of K^+-uptake by K^+-depleted micas on the basal spacing: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 335–340, illus., tables, 1968.

Potassium was introduced into expanded, i.e., K^+-depleted, micas by adding about 0.5 symmetry of KCl to a chromatographic column of expanded mica plus sand and by equilibrating suspensions of Ca^{2+} or Mg^{2+}-saturated expanded mica with 0.5, 1.0, 1.5, and 2.0 symmetry of KCl. Two expanded biotites readily formed a regular alternation of 10 and 14A spacings, whereas two muscovites did not develop such a phase. A phlogopite yielded this phase only at the lowest concentration of K^+ tested. Regular alternation developed most readily in the Ca^{2+}-saturated minerals. Development of regular interstratification did not appear to be related to the gross surface-charge-density of the minerals, but did seem to be positively related to the content of octahedral Fe.—Authors' abstract

02502 **Weertman, J.** Bubble coalescence in ice as a tool for the study of its deformation history [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 155–159, illus., 1968.

An analysis is made of the rate of bubble coalescence in an ice mass that is deforming. A total strain of at least eight is required before appreciable coalescence occurs. The analysis has been applied to deforming ice shelves and ice sheets. No appreciable coalescence is expected in ice shelves but coalescence should occur in ice sheets (or glaciers) if the shear strain-rate at the bottom surface is of the order of 0.075 per yr or larger. Measurements of bubble concentration are capable of setting limits on paleo-strain-rates of the present ice sheets. Bubble migration down temperature gradients presents complications to the study of bubble coalescence.—Author's abstract

02543 **Weertman, J.** Diffusion law for the dispersion of hard particles in an ice matrix that undergoes simple shear deformation [with French and German abs.]: Jour. Glaciology, v. 7, no. 50, p. 161–165, illus., table, 1968.

A diffusion equation is obtained that describes the mechanical dispersion of a dilute mixture of solid particles within an ice matrix that is undergoing deformation. It is shown that within the limits of time intervals and strain-rates appropriate to the movement of glaciers and ice sheets, the dispersal distance usually is no larger than a distance about one order of magnitude greater than the size of the particles themselves.—Author's abstract

02574 **Weertman, J.** Comparison between measured and theoretical temperature profiles of the Camp Century, Greenland, borehole: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 246, 13 p., illus., tables, 1968.

Steady-state temperature profiles were found by modifying Robin's theory through the addition of several correction terms. One of these terms is the internal heating arising from creep deformation. The importance of this term was emphasized by Lliboutry. The new theoretical profiles do not differ appreciably from the profile derived from Robin's theory. They do differ substantially from the Camp Century profile measured by Hansen. It is concluded that Hansen's observations are evidence that factors such as accumulation rate and the upper surface temperature are not in a long-term steady-state condition. Better agreement between theoretical and measured curves is obtained if it is assumed that the accumulation rate was about 40 percent smaller in the past and that the mean annual surface temperature varied by about 0.5°C over the past 1,000 years.—*from* Author's abstract

02593 **Weld, Betsy A.; Griffin, Margaret S.; Brett, George W.** Reports and maps of the Geological Survey released only in the open files, 1967: U.S. Geol. Survey Circ. 548, 21 p., 1968.

This circular contains a list of maps and reports released by the U.S. Geological Survey during 1967 that are available for public inspection in the open files. These maps and reports may be consulted at the indicated depositories (a list is included), and copies will be made upon request (at the requestor's expense). The reports are arranged alphabetically by author; each report is preceded by a serial number that is used to identify it in the index, and is followed by the depositories at which it may be consulted.—*from* Authors' introduction

02204 **Weller, J. Marvin.** Evolution of mammalian teeth: Jour. Paleontology, v. 42, no. 2, p. 268–290, illus., 1968.

Tooth evolution in primitive fishes from structures similar to dermal denticles in skin of modern sharks contributed to the success of vertebrates. Teeth of fishes ancestral to higher vertebrates were simple cones useful in holding prey. In the Permian, teeth of some pelycosaurian reptiles began to differentiate by appearance of canine-like fangs. Further differentiation followed among the mammal-like therapsid reptiles. Modernized triangular teeth with three main cusps first appeared in the Cretaceous. From Paleocene onward, molars were progressively specialized functionally in relation to feeding habits.—*from* Author's abstract

02557 **Welp, T. L.; Isenberger, K. J.; Dubberke, W.; Myers, J.** Geological Society of Iowa field trip—Middle River traverse [March 23, 1968]: [Iowa City, Iowa] Geol. Soc. Iowa, [16] p., illus., 1968.

The purpose of this trip is to examine Missourian and Virgilian rocks exposed along the Middle River valley and its tributaries in Madison and Adair Counties, Iowa; and to present a correlation and structural interpretation of exposures near Howe. The formations included are remarkable in their persistence throughout the midcontinent region, but are considerably thinner in this more northern area than in the type areas; in the absence of major limestones, correlation of the shale units has been difficult. A graphic column of the rocks of the Pennsylvanian System is included, as well as measured sections of nine exposures.—GDC

07447 **Wetherill, G. W.** Collisions in the asteroid belt and the origin of meteorites [abs.]: Meteoritics, v. 3, no. 3, p. 135, 1967.

Wetherill, George W. *See* Wasson, John T. 07446

Wheeler, E. P., 2d. *See* Boone, Gary M. 02209

Wheeler, J. O. *See* Roddick, J. A. 07493

07448 **Whipple, Fred L.** Before Type I carbonaceous chondrites [abs.]: Meteoritics, v. 3, no. 3, p. 135–136, 1967.

White, O. L. *See* Karrow, P. F. 02403

02566 **Whitehead, R. L.; Sisco, H. G.** Ground-water levels in Idaho, 1968: Idaho Dept. Reclamation Water Inf. Bull. 5, 67 p., illus., tables, 1968.

Ground-water levels in Idaho vary considerably depending on geographic location of the well, producing aquifer, quantity and rate of withdrawal from or in the vicinity of the well, and time of year when measurements are made. Long-term declines or rises may result from climatic changes or changes in quantities pumped per unit of time. This annual report presents maps showing location of all network wells, water levels measured during spring of 1968, water-level changes occurring between spring of 1967 and spring of 1968, and hydrographs representative of water-level trends.—MCM

02384 **Whitten, Charles A.** Earthquake damage, Montague Island, Alaska, *in* Manual of color aerial photography: Falls Church, Va., Am. Soc. Photogrammetry, p. 390–391, illus., 1968.

A color photograph of the Hanning Bay fault scarp, taken four months after the Alaskan earthquake of March 1964, shows the differential uplift in the area, the greater seaward displacement of 15 feet along this section of the fault, and the newly formed beach clearly marked by white calcareous remains. The trace of the fault scarp as it passes beneath the water is much more sharply defined than in contemporaneous panchromatic and infrared photographs. If the vertical displacement on seaward side had been a few feet greater, a lake would have been formed similar to one on shore that probably was enclosed by some earlier uplift.—GDC

02290 **Wiggins, Ralph A.** Terrestrial variational tables for the periods and attenuation of the free oscillations: Physics Earth and Planetary Interiors, v. 1, no. 4, p. 201–266, illus., tables, 1968.

Perturbations of the Lagrangian integral for free oscillations of a radially heterogeneous self gravitating sphere are used to compute tables relating the variation of periods and attenuation to the physical parameters. These tables are given for the fundamental and first and second overtones of the torsional and spheroidal free oscillations. Such tables can be used to determine Earth models that are consistent with the observed periods of the free oscillations.—Author's abstract

02223 **Wilcox, Ray E.; Izett, Glen A.** Optic angle determined conoscopically on the spindle stage—[Pt.] 2, Micrometer ocular method: Am. Mineralogist, v. 53, nos. 1–2, p. 269–277, illus., tables, 1968.

Optic angle may be determined if one or both melatopes of the optic axes pass through some part of the conoscopic field during rotation of the crystal fragment about the spindle axis. With the spindle pointed north, the orientation of each optic axis is established by the amount of rotation about the spindle axis required to place the melatope on the N–S crosshair and by the angular distance of the melatope north or south of the microscope axis as determined by a general extension of Mallard's method, using a calibrated ocular micrometer. After plotting the two optic axes, the value of 2V may be read off the stereogram. Should only the optic

axis pass through the conoscopic field, a somewhat less precise value of optic angle may be obtained by doubling the angle V.—Authors' abstract

07384 **Wilkinson, Elbert R.** Hollister field, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Sec., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists Pacific Sec., p. 95–98, illus., 1967.

Hollister field, Calif., is divided into the northwestern or Lomerias portion and the gas-producing Flint Hills area in the southeast. Several wells in the Lomerias area produced a little oil and gas from the Franciscan between 1950 and 1953 but declined rapidly and were abandoned. The discovery well in the Flint Hills area, completed in 1951 in the Purisima, has produced 7,201,606 mcf of gas and 6,376 bbl of oil to date. The gas-producing Pliocene sediments were deposited on the Franciscan in a Tertiary trough. Stratigraphy of the field is tabulated, and cross sections and structure maps of both areas accompany the report.—ESL

Williams, Harold. *See* Neale, E. R. W. 07403

07416 **Williams, Harold.** Silurian rocks of Newfoundland [with French abs.], *in* Collected papers on geology of the Atlantic region—Hugh Lilly Memorial Volume: Geol. Assoc. Canada Spec. Paper 4, p. 93–137, illus., tables, 1967.

Mainly of Llandovery and early Wenlock age, these rocks everywhere have remarkably similar transitional facies in four lithic units: (1) and (2) shallow-marine graywackes and conglomerates, confined to central Newfoundland, conformably overlie Middle Ordovician graptolitic slates; (3) terrestrial volcanic rocks and (4) micaceous sandstones on earlier Silurian units, Ordovician, or Cambrian rocks. The contrasted facies, with Silurian rocks indiscriminately upon Ordovician platforms and volcanic mobile zones across insular Newfoundland, indicate little in common between Silurian and earlier Paleozoic evolution of the Appalachians. Silurian deposition appears to have been in local basins, now fault-bounded belts, bordered by contemporaneous tectonic lands and marked by important volcanic episodes, predating Acadian orogeny.—GDC

Williams, James H. *See* Parizek, Eldon J. 02600

Willman, H. B. *See* Frye, John C. 02340

Willman, H. B. *See* Frye, John C. 02533

07423 **Wilson, C. H.** Melanochalcite from the Algomah mine, Ontonagon County, Michigan: Compass, v. 45, no. 1, p. 45–46, table, 1967.

Current investigations of polished sections of Algomah copper ore have revealed considerable amounts of a black massive pitchy material fitting the description of the colloidal mineral mixture melanochalcite or "copper pitch ore". Chemical analyses of four specimens verify that the material is definitely melanochalcite. Considerable variation in composition occurs.—BSH

02443 **Wilson, John Andrew; Twiss, P. C.; DeFord, Ronald K.; Clabaugh, S. E.** Stratigraphic succession, potassium-argon dates, and vertebrate faunas, Vieja Group, Rim Rock country, Trans-Pecos, Texas: Am. Jour. Sci., v. 266, no. 7, p. 590–604, illus., tables, 1968.

Potassium-argon dates from a superpositional succession of igneous and sedimentary rocks of the Vieja, Garren, and Buck Hill Groups are critically evaluated. Five new faunas of vertebrate fossils collected from the interbedded tuffs are named, and tentative faunal lists are given. Misidentification of fossil vertebrates in an earlier collection are corrected. Abandonment of a previously published K-Ar date of 33.1 m.y. is urged because of lack of stratigraphic and geographic data. An Eocene-Oligocene boundary based upon vertebrates seems to fall within the Duchesnean Age.—Authors' abstract

02500 **Wilson, L. R.; Muhammad, A. Rashid.** Palynological evidence for the age of the Bostwick Member of the Dornick Hills Group (Pennsylvanian) of Oklahoma [abs.]: Oklahoma Geology Notes, v. 28, no. 3, p. 119, 1968.

02528 **Wilson, L. R.** New water-miscible mountant for palynology: Micropaleontology, v. 14, no. 2, p. 247-248, 1968.

A water-miscible mounting medium consisting of gelatin, gum arabic, glycerin, phenol or formaldehyde, and water has been found satisfactory for most palynological work when speed of slide preparation and permanence of retention of fossils are desired.—Author's abstract

02392 **Wimpfen, Sheldon P.; Severinghaus, Nelson, Sr.** Application and economics, industrial minerals, *in* Surface mining (E. P. Pfleider, editor): New York, Am. Inst. Mining, Metall. and Petroleum Engineers, p. 849-873, illus., tables, 1968.

The demand for industrial minerals is expected to increase; production is now more than twice the dollar value of metals. Exploration and development practices are reviewed, and it is pointed out that drillhole data are the most frequently used information in exploration and development. Other subjects discussed are: planning and engineering design, unit operations, general operations, and economics.—ESL

02560 **Winters, Allen S.** Geology and ore deposits of the Castle Mountain mining district, Meagher County, Montana: Montana Bur. Mines and Geology Bull. 64, 64 p., illus., table, geol. maps, 1968.

This mountainous district is on the southeastern flank of the Castle stock, which rises to 8,606 feet above sea level. Sedimentary rocks, Precambrian to Cretaceous in age, have been uplifted by intrusion of two separate stocks, which produced both longitudinal and radial fractures. Metamorphism is not strong, but igneous and sedimentary rocks both have been hydrothermally altered by low and medium temperature processes. Metalliferous deposits contain lead, zinc, and silver, and minor copper, manganese and gold. The sulfide minerals are commonly associated with jasper and magnetite, and found mainly in altered Paleozoic limestone. Geological maps and geochemical dispersion patterns of the district and a few of the properties are presented, along with production data and historical information.—*from* Author's abstract

Winters, Harold A. *See* Stradling, Dale F. 07357

Witherspoon, Paul A. *See* Javandel, Iraj. 02581

Wlotzka, F. *See* Begemann, F. 07452

07512 **Wobber, Frank J.** Space photography—A new analytical tool for the sedimentologist: Sedimentology, v. 9, no. 4, p. 265-317, illus., 1967.

Orbital remote sensing, and particularly space photography, provide useful synoptic environmental data. Color photographs obtained on Gemini flights provide unique tools for analyzing sedimentary environments and processes and provide data that cannot be duplicated by conventional aerial photographic techniques. The principal advantages are frequency of coverage, leading to seasonal-variation studies, and opportunities for synthesis by synoptic observations. Gemini space photography is an available source of semi-quantitative data concerning changing environmental phenomena and mechanisms of sediment distribution and also permits an inventory of global landforms. With applications of other sensors, even better sedimentological analyses can be performed.—*from* Author's summary

Wolfe, E. W. *See* Allen, C. R. 02580

Wood, Gordon H., Jr. *See* Trexler, J. Peter. 02273

07367 **Woodrow, D. L.; Sutton, R. G.; Rukavina, N. A.** A drowned beach in Lake Ontario west of Rochester, New York, *in* Conf. on Great Lakes Research, 10th,

Toronto, Ontario, 1967, Proc.: Ann Arbor, Mich., Internat. Assoc. Great Lakes Research, p. 157–161, illus., 1967.

Fathometer traces, cores, and grab-samples were utilized to determine the configuration of the bottom and the distribution of bottom sediments in nearshore Lake Ontario between Rochester and Braddock Point, N. Y. The data indicate a smooth, sandy bottom extending from the present shoreline to water depths of 25 feet. A rough, steeply sloping bottom with boulder accumulations exists between water depths of 25 and 50 feet. At water depths greater than 50 feet the bottom is smooth and silty. The boulder zone is parallel to the modern shoreline and is approximately one-half mile offshore. The writers interpret the boulder zone as a drowned beach. The bays and swamps landward of the drowned beach have been covered by modern lake sediments.—Authors' abstract

07388 **Wornardt, Walt W., Jr.** Siliceous microfossils from the Bickmore Canyon diatomite and the Pancho Rico Formation, *in* Gabilan Range and adjacent San Andreas fault—AAPG and SEPM Pacific Sec., Joint Ann. Field Trip, 1967, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 48–53, illus., table, 1967.

Diatoms are the predominant fossils in late Miocene and early to middle Pliocene rocks in California; a checklist is included. The flora from the Bickmore Canyon Diatomite is compared with that from the Monterey and Modelo Formations, and that from the Pancho Rico, with the Sisquoc and Etchegoin Formations. Both floras are illustrated.—ESL

07449 **Wright, Frances W.; Franklin, Fred A.; Hodge, Paul W.; Langway, Chester C.** Determination of the densities of individual meteoritic, glacial, and volcanic spherules [abs.]: Meteoritics, v. 3, no. 3, p. 136, 1967.

02224 **Wright, Thomas L.** X-ray and optical study of alkali feldspar—[Pt.] 2, An X-ray method for determining the composition and structural state from measurement of 2θ values for three reflections: Am. Mineralogist, v. 53, nos. 1–2, p. 88–104, illus., tables, 1968.

Measured 2θ values of the $\bar{2}01$, 060, and $\bar{2}04$ diffraction peaks of natural and synthetic alkali feldspars empirically can be linearly related to the a, b, and c cell parameters, respectively. The structural state of many alkali feldspars may be estimated directly from a plot of 2θ (060) against 2θ ($\bar{2}04$) prepared for feldspars of known structural state. Feldspars having anomalous cell dimensions may also be recognized on such a plot. Composition of feldspars having normal cell dimensions may be determined from 2θ ($\bar{2}01$). Starting parameters for a computer refinement of the cell may be obtained from equations relating cell dimension to 2θ value of a single diffraction peak for a wide variety of natural, synthetic, and cation-exchanged alkali-feldspar phases.—*from* Author's abstract

02225 **Wright, Thomas L.; Stewart, David B.** X-ray and optical study of alkali feldspar—[Pt.] 1, Determination of composition and structural state from refined unit-cell parameters and $2V$: Am. Mineralogist, v. 53, nos. 1–2, p. 38–87, illus., tables, 1968.

Samples of alkali feldspar of equivalent structural state prepared by alkali exchange from the same starting material show a continuous variation in unit-cell parameters and optic angle with composition. Determinative curves of b vs c (and contoured for a) permit both the estimation of the structure state and the detection of "anomalous" unit cells. Composition may be determined directly from a if a is not crystallographically "anomalous", or from unit-cell volume if a is "anomalous". An appendix describes in detail the measurement and indexing of the X-ray powder diffraction patterns of an alkali feldspar preparatory to computer refinement of unit-cell parameters.—*from* Authors' abstract

02261 **Wright, W. R.; Foss, J. E.** Movement of silt-sized particles in sand columns: Soil Sci. Soc. America Proc., v. 32, no. 3, p. 446–448, illus., table, 1968.

Plastic columns containing fine or medium sand, and capped with fine or medium silt, were leached with distilled water. Both coarse and fine silt moved readily

through the medium sand; however, only the fine silt moved appreciably through the fine sand. Deposition of the fine silt in bands was also observed in the fine sand columns.—Authors' abstract

02584 **Wrucke, Chester T.; Armbrustmacher, Theodore J.; Hessin, Thomas D.** Distribution of gold, silver and other metals near Gold Acres and Tenabo, Lander County, Nevada: U.S. Geol. Survey Circ. 589, 19 p., illus., 1968.

Geochemical investigations in a 70-sq-mi area on the Shoshone Range's east flank has resulted in delineation of two well-defined northwest-trending belts containing anomalous concentrations of antimony, arsenic, bismuth, cadmium, copper, gold, lead, mercury, molybdenum, silver, tin, tungsten, and zinc. A third poorly defined belt is enriched in a few of these elements. Each belt is 1–2 mi wide and 506 mi long and contains a slightly different suite of metals associated with gold. Strong concentrations of silver occur in the western parts of the two main belts, whereas gold is greatly enriched in the eastern parts, especially around the granodiorite stock at Tenabo and on the flank of a magnetic anomaly thought to represent a buried stock at Gold Acres.—*from* Authors' abstract

Wyllie, P. J. *See* Boettcher, A. L. 02521

Wyss, M. *See* Allen, C. R. 02580

02335 **Wyss, Max; Brune, James N.** Seismic moment, stress, and source dimensions for earthquakes in the California-Nevada region: Jour. Geophys. Research, v. 73, no. 14, p. 4687–4694, illus., table, 1968.

The source mechanism of earthquakes in the California-Nevada region was studied. Fourier analysis of surface waves from 13 earthquakes in the Parkfield region have yielded a relationship between seismic moment, M_o, and Richter magnitude, M_L which was used to estimate the seismic moment of 259 additional earthquakes in the western United States. The combined data yield the following relationship between moment and local magnitude: $\log M_o = 1.7M_L + 15.1$, where $3 < M_L < 6$. These data together with the Gutenberg-Richter energy-magnitude formula suggest that the average stress multiplied by the seismic efficiency is about 7 bars for small earthquakes at Parkfield and in the Imperial Valley, about 30 bars for small earthquakes near Wheeler Ridge on the White Wolf fault, and over 100 bars for small earthquakes in the Arizona-Nevada and Laguna Salada (Baja California) regions.—*from* Authors' abstract

02220 **Yaalon, D. H.; Koyumdjisky, H. A.** A comparison of ammonium and sodium acetate extraction for displacing exchangeable potassium in soils: Soil Sci., v. 105, no. 6, p. 403–408, illus., 1968.

The higher replacing power of NH_4 and the replacement of K from specific sites more easily accessible to NH_4 are considered to be the main factors responsible for the results of the moderately leached montmorillonite soils containing small amounts of kaolinite and illite. NH_4OAc replaced about 50 percent more K than NaOAc. Small amounts of replaceable K in the more leached soils with a low level of exchangeable K is attributed to NH_4 fixation and lattice contraction of the partially opened mica structure. This results in the blocking of some of the exchangeable ions.—JWH

Yamada, Hiroshi. *See* Wada, Koji. 02229

02198 **Yasutomi, Rokyro; Sudo, Seiji.** A concept of softening and hardening of clay based upon the change in soil structure by remolding: Soil Sci., v. 105, no. 6, p. 384–391, illus., 1968.

The recovery of soil structure after remolding is in many cases irreversible. Clay soil behavior depends mainly on the surface affinity for water of the soil particles. The author treats softening and hardening from the viewpoint of the change in energy in the soil-water system (pF) and the change of mechanical structure of soil by remolding. An attempt is made to classify the process of softening and hardening

which will give a prospect for analysis of the soil–water system in connection with soil energy.—JWH

07420 **Zaitzeff, James B.** Middle Ordovician Black River ostracods from a well core, Jackson County, Michigan: Compass, v. 45, no. 1, p. 26–32, 1967.

Ostracods representing 31 species distributed among 16 genera are studied from a well core from the Black River Formation of Jackson County, Michigan. Twenty–three species are observed to be new. Most of the species are distributed among seven zones within the core. A second occurrence of *Platybolbina* Henningemoen in North America is noted and many specimens of leperditiids with spines, which have been previously thought to be unusual in the family Leperditiidae, are observed.—Author's abstract

02366 **Zietz, Isidore; Kirby, John R.** Transcontinental geophysical survey (35°–39° N)—Magnetic map from 112° W longitude to the coast of California: U.S. Geol. Survey Misc. Geol. Inv. Map I–532–A, scale 1:1,000,000, 1968.

02367 **Zietz, Isidore; Kirby, John R.** Transcontinental geophysical survey (35°–39° N)—Magnetic map from 100° to 112° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I–533–A, scale 1:1,000,000, 1968.

02368 **Zietz, Isidore; Kirby, John R.** Transcontinental geophysical survey (35°–39° N)—Magnetic map from 87° to 100° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I–534–A, scale 1:1,000,000, 1968.

02369 **Zietz, Isidore; Stockard, H. P.; Kirby, John R.** Transcontinental geophysical survey (35°–39° N)—Magnetic and bathymetric map from 74° to 87° W longitude: U.S. Geol. Survey Misc. Geol. Inv. Map I–535–A, scale 1:1,000,000, 1968.

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